KIPS
ENTRY TESTS
SERIES

PRACTICE BOOK
KIPS SATs
Self Assessment Tests

PHYSICS

MDCAT

AS PER UHS SYLLABUS

- [illegible] Practice MCQs
- Quest[illegible] Past Papers
- Answer Keys [illegible] Notes
- Topic-wise Practice Exercises
- Unit-wise Self Assessment Tests
- Pre-Assessment Test (Diagnostic Test)
- Post-Assessment Test (Sample Paper as per Original Format)

A Kitab Dost Publication

CONTENT

UNIT WISE

PRE-ASSESSMENT TEST

Q.1 If 'muscle time speed equals power', what is the ratio of the SI unit and the CGS unit of muscle?

A) 10^5
B) 10^3
C) 10^7
D) 10^{-5}

Q.2 The equation of the stationary wave is:

$$y = 2A\sin\left(\frac{2\pi ct}{\lambda}\right)\cos\left(\frac{2\pi x}{\lambda}\right)$$

Which of the following statement is wrong?

A) The unit of ct is same as that of λ
B) The unit of x is same as that of λ
C) The unit of $2\pi c/\lambda$ is same as that of $2\pi x/\lambda t$
D) The unit of c/λ is same as that of x/λ

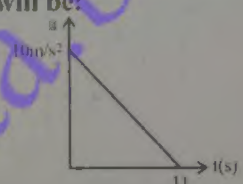
Q.3 The least count of a stop watch is 0.1 sec. The time of 20 oscillations of the pendulum is found to be 20 sec. The percentage error in the time period is:

A) 0.25%
B) 0.5%
C) 0.75%
D) 1.0%

Q.4 An experiment measured quantities a, b, c and then x is calculated from $x = ab^2/c^3$. If the percentage errors in a, b, c are $\pm 1\%$, $\pm 13\%$ and $\pm 2\%$ respectively, the percentage error in x can be:

A) $\pm 13\%$
B) $\pm 51\%$
C) $\pm 41\%$
D) $\pm 33\%$

Q.5 A particle starts from rest. Its acceleration (a) versus time (t) is as shown in the figure. The average speed of the particle will be:

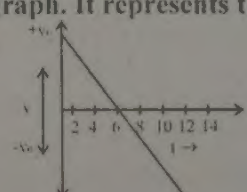


A) 110 m/s
B) 55 m/s
C) 550 m/s
D) 660 m/s

Q.6 A body starts from rest; what is the ratio of the distance travelled by the body during the 4th and 3rd second?

A) 7/5
B) 5/7
C) 7/3
D) 3/7

Q.7 Consider the given velocity-time graph. It represents the motion of:



A) a projectile projected vertically upward, from a point
B) an electron in the hydrogen atom
C) a car with constant acceleration along a straight road
D) a bullet fired horizontally from the top of a tower

Q.8 **A projectile is thrown at an angle of 40° with the horizontal and its range is R_1. Another projectile is thrown at an angle 40° with the vertical and its range is R_2. What is the relation between R_1 and R_2?**

A) $R_1 = R_2$
B) $R_1 = 2R_2$
C) $R_2 = 2R_1$
D) $R_1 = \frac{4R_2}{5}$

Q.9 **A person holds a bucket of weight 60 N. He walks 7 m along the horizontal path and then climbs up a vertical distance of 5m. The work done by the gravity is:**

A) 300 N-m
B) 720 N-m
C) 420 N-m
D) 0 N-m

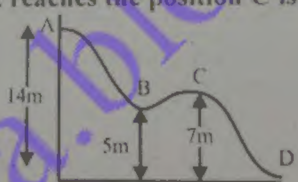
Q.10 **Two masses of 1 g and 9 g are moving with equal kinetic energies. The ratio of the magnitudes of their respective linear momenta is:**

A) 1 : 9
B) 9 : 1
C) 1 : 3
D) 3 : 1

Q.11 **Two trucks, one loaded (A) and the other unloaded (B) are moving and have same kinetic energy. The mass of A is double than that of B. Brakes are applied to both and are brought to rest. If distance covered by A before coming to rest is s_1 and that by B is s_2, then:**

A) $s_1 = s_2$
B) $s_1 = 2s_2$
C) $2s_1 = s_2$
D) $s_1 = 4s_2$

Q.12 **Figure shows the vertical section of frictionless surface. A block of mass 2 kg is released from the position A; its KE as it reaches the position C is**



A) 180 J
B) 140 J
C) 40 J
D) 280 J

Q.13 **The slope of the kinetic energy versus position vector gives the rate of change of:**

A) momentum
B) velocity
C) force
D) power

Q.14 **An elevator's motor produces 3000 W power. The speed with which it can lift a 1000 kg load is:**

A) 30.6 ms^{-1}
B) 3.06 ms^{-1}
C) 0.306 ms^{-1}
D) 300.6 ms^{-1}

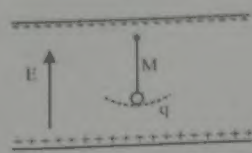
Q.15 **The displacement of a particle executing SHM is given by $x = 0.01 \sin 100\pi\,(t+0.05)$. The time period is:**

A) 0.01 sec
B) 0.02 sec
C) 0.1 sec
D) 0.2 sec

Q.16 **A particle is executing SHM with amplitude A and has maximum velocity v_o. Its speed at displacement A/2 will be:**

A) $(\sqrt{3})v_o/2$
B) $v_o/\sqrt{2}$
C) v_o
D) $v_o/4$

Q.17 A uniform vertical field E is established between two parallel plates. In this field, a small conducting sphere of mass M is suspended from a string of length l. If the sphere is given a charge +q (coulomb) and if lower plate is charged positively, the period of the simple pendulum is:



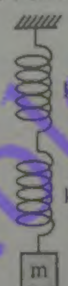
A) $2\pi\sqrt{\frac{\ell}{g}}$

B) $2\pi\sqrt{\frac{\ell}{\left(g+\frac{qE}{m}\right)}}$

C) $2\pi\sqrt{\frac{\ell}{\left(g-\frac{qE}{m}\right)}}$

D) $2\pi\sqrt{\frac{\ell}{\left(\frac{qE}{m}-g\right)}}$

Q.18 A mass m is suspended from two springs of constants k_1 and k_2 as shown. The time period of vertical oscillations of the mass will be:



A) $2\pi\sqrt{\left(\frac{k_1+k_2}{m}\right)}$

B) $2\pi\sqrt{\left(\frac{m}{(k_1+k_2)}\right)}$

C) $2\pi\sqrt{\left(\frac{m(k_1k_2)}{(k_1+k_2)}\right)}$

D) $2\pi\sqrt{\left(\frac{m(k_1+k_2)}{(k_1k_2)}\right)}$

Q.19 A particle executes SHM with amplitude of 20 cm and time period of 12 sec. What is the minimum time required for it to move between two points 10 cm on either side of the mean position?

A) 1 sec

B) 2 sec

C) 3 sec

D) 4 sec

Q.20 If the maximum velocity and acceleration of a particle executing SHM are equal in magnitude, the time period will be:

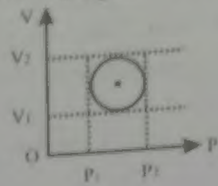
A) 1.57 sec

B) 3.14 sec

C) 6.28 sec

D) 12.56 sec

Q.21 In the cyclic process shown on the P – V diagram the magnitude of the work done is:



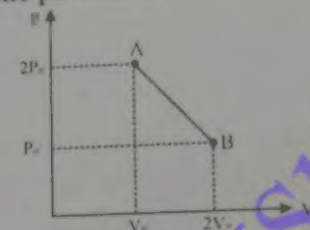
A) $\pi\left(\frac{P_2-P_1}{2}\right)^2$

B) $\pi\left(\frac{V_2-V_1}{2}\right)^2$

C) $\frac{\pi}{4}(P_2-P_1)(V_2-V_1)$

D) $\pi(P_2V_2-P_1V_1)$

Q.22 n moles of an ideal gas undergo a process A → B as shown in the figure. Maximum temperature of the gas during the process is:



A) $\frac{3P_oV_o}{2nR}$

B) $\frac{9P_oV_o}{4nR}$

C) $\frac{9P_oV_o}{2nR}$

D) $\frac{9P_oV_o}{nR}$

Q.23 If 150 J of heat is added to a system and the work done by the system is 110 J, then change in internal energy will be:

A) 260 J

B) 150 J

C) 110 J

D) 40 J

Q.24 In Young's double slit experiment the wavelength of light was changed from 7000 Å. While doubling the separation between the slits which of the following is not true for this experiment?

A) The width of the fringes changes

B) The colour of the bright fringes changes

C) The separation between successive bright fringes changes

D) The separation between successive dark fringes remains unchanged

Q.25 The force between two charges situated in air is F. The force between the same charges if the distance between them is reduced to half and they are situated in a medium having dielectric constant 4 is:

A) F/4

B) 4F

C) 16F

D) F

Q.26 If the force between the electron in the first Bohr orbit and the nucleus (proton) in hydrogen atom is F, then the force between them when the electron is in the second orbit is:

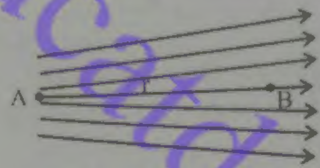
A) 4F

B) F/4

C) F/9

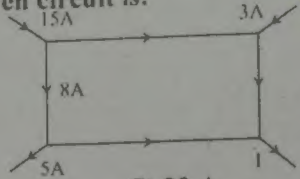
D) F/16

Q.27 **The given figure shows the electric lines of force emerging from a charged body. If the electric fields at A and B are E_A and E_B respectively and if the displacement between A and B is r, then:**



A) $E_A > E_B$
B) $E_A < E_B$
C) $E_A = \frac{E_B}{r}$
D) $E_A = \frac{E_B}{r^2}$

Q.28 **The value of current I in the given circuit is:**



A) 3 A
B) 13 A
C) 23 A
D) –3 A

Q.29 **The resultant resistance value of n resistances, each of r ohm when connected in parallel, is x. When these n resistances are connected in series, the resultant value is:**

A) nx
B) n^2x
C) rnx
D) r^2x/n

Q.30 **A primary cell has e.m.f. 2 volt. When short-circuited it gives a current of 4 amp. Its internal resistance in ohm will be:**

A) 0.5
B) 2
C) 5
D) 8

Q.31 **The masses of three wires of copper are in the ratio of 1 : 3 : 5 and their lengths are in the ratio 5 : 3 : 1. The ratio of their electrical resistance is:**

A) 1 : 3 : 5
B) 5 : 3 : 1
C) 1 : 15 : 125
D) 125 : 15 : 1

Q.32 **A small piece of wire is passed through the gap between the poles of a magnet in 0.1 sec. An e.m.f. of 4×10^{-8} V is induced in the wire, the magnetic flux between the poles is:**

A) 10 Wb
B) 0.1 Wb
C) 4×10^{-9} Wb
D) 4×10^{-2} Wb

Q.33 **What is the charge induced in coil of 100 turns of resistance 100Ω, if magnetic flux changes from 2 T m² to – 2 T m²?**

A) 4 C
B) 2 C
C) 2.8 C
D) 0.4 C

Q.34 **A coil having an area A_o is placed in a magnetic field which changes from B_o to $4B_o$ in time interval t. The e.m.f. induced in the coil will be:**

A) $3A_oB_o/t$
B) $4A_oB_o/t$
C) $3B_o/A_ot$
D) $4B_o/A_ot$

Q.35 **The peak value of an alternating e.m.f. E given by:**

$E = E_o \cos\omega t$

Is 10 volt and frequency is 50 Hz. At time t = (1/600) sec, the instantaneous value of e.m.f. is:

A) 10 volt
B) $5\sqrt{3}$ volt
C) 5 volt
D) 1 volt

Q.36 A solenoid 1.5 m long and 0.4 cm in diameter possesses 10 turns per cm length. A current of 5 A flows through it. The magnetic field at the axis inside the solenoid is:
A) $2\pi \times 10^{-3}$T
B) $2\pi \times 10^{-5}$T
C) $4\pi \times 10^{-2}$T
D) $4\pi \times 10^{-3}$T

Q.37 When a charged particle moving with velocity $\vec{v}$ is subjected to a magnetic field of induction $\vec{B}$, the force on it is non-zero. This implies that:
A) angle between $\vec{v}$ and $\vec{B}$ is either zero or 180°
B) angle between $\vec{v}$ and $\vec{B}$ is necessarily 90°
C) angle between $\vec{v}$ and $\vec{B}$ can have any value other than 90°
D) angle between $\vec{v}$ and $\vec{B}$ can have any value other than zero and 180°

Q.38 An electric field of 1500 V/m and a magnetic field of 0.40 weber/metre^2 act on a moving electron. The minimum uniform speed along a straight line the electron could have is:
A) 1.6×10^{15} m/s
B) 6×10^{-16} m/s
C) 3.75×10^{3} m/s
D) 3.75×10^{2} m/s

Q.39 If an electron describes half a revolution in a circle of radius r in a magnetic field B, the energy acquired by it, is:
A) zero
B) $\frac{1}{2}mv^2$
C) $\frac{1}{4}mv^2$
D) $\pi r \times Bev$

Q.40 If the velocity of a charged particle is doubled and strength of magnetic field is halved, then radius becomes:
A) 8 times
B) 2 times
C) 4 times
D) (1/2) times

Q.41 An electron of mass m_e and a proton of mass m_p are accelerated through the same potential difference. The ratio of the de Broglie wavelength associated with an electron to that associated with proton is:
A) 1
B) m_p/m_e
C) m_e/m_p
D) $\sqrt{m_p/m_e}$

Q.42 The work function of a metal is 2.5 eV. If a radiation of wavelength 4000 Å falls on it, the maximum kinetic energy of emitted photoelectrons is:
A) 2.5 eV
B) 3.1 eV
C) 5.6 eV
D) 0.6 eV

Q.43 In Bohr's model, the atomic radius of the first orbit is r_o; then the radius of the third orbit is:
A) $r_o/9$
B) r_o
C) $9\,r_o$
D) $3r_o$

Q.44 The ratio of the energies of the hydrogen atom in its first to second excited states is:
A) 1/4
B) 4/9
C) 9/4
D) 4

Q.45 An X-ray tube operated at 30 kV emits a continuous X-ray of short wavelength limit λ = 0.414 Å. The value of Planck's constant is:
A) 6.62×10^{-34} J-sec
B) 6.6×10^{-34} J-sec
C) 6.7×10^{-34} J-sec
D) 6.67×10^{-31} J-sec

Q.46 [illegible] with a half-life of 24000 years. If plutonium is stored for 72000 years, the fraction of it that remains is:
A) 1/8
B) 1/3
C) 1/4
D) 1/2

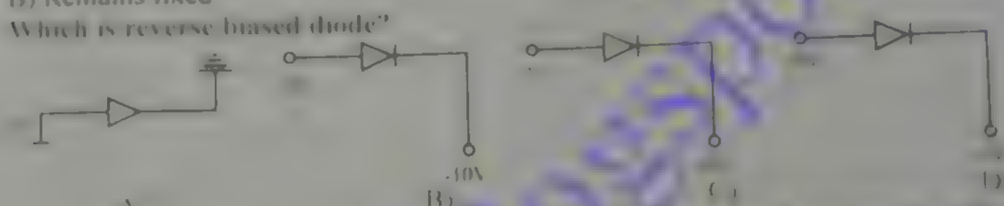
Q.47 The half-life of radioactive radon is 3.8 days. The time at the end of which [illegible] of the radon sample will remain un-decayed, is:
A) 3.8 days
B) 16.5 days
C) 33 days
D) 76 days

Q.48 The half-value period of a radioactive nuclide is 3 hours. In 9 hours its activity will be reduced by a factor of:
A) [illegible]
B) (1/27)
C) [illegible]
D) (1/8)

Q.49 In fusion the percentage of mass converted into energy is about
A) [illegible]
B) 1%
C) [illegible]
D) 0.01%

Q.50 On increasing the reverse bias to a large value in a P-N junction diode, current
A) Increases slowly
B) Remains fixed
C) Suddenly increases
D) Decreases slowly

Q.51 Which is reverse biased diode?

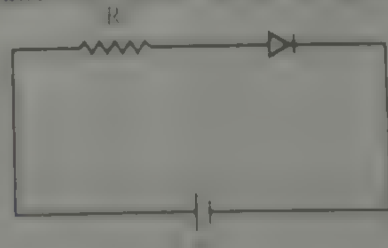


Q.52 When forward bias is applied to a P-N junction, then what happens to the potential barrier V_B, and the width of charge depleted region x
A) V_B increases, x decreases
B) V_B decreases, x increases
C) V_B increases, x increases
D) V_B decreases, x decreases

Q.53 If a full wave rectifier circuit is operating from 50 Hz mains, the fundamental frequency in the ripple will be
A) 50 Hz
B) 70.7 Hz
C) 100 Hz
D) 25 Hz

Q.54 In order to forward bias a P-N junction, the negative terminal of battery is connected to
A) P-side
B) [illegible] N-side
C) N-side
D) None of these

Q.55 For the given circuit of P-N junction diode, which of the following statement is correct?



A) [illegible]
B) [illegible]
C) [illegible]
D) [illegible]

Q.56 No. of neutron in nucleus is expressed by

A) A

B) Z

C) A [illegible]

D) A - Z

Q.57 Which of given is correct equation for mass defect.

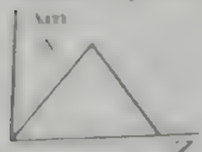
A) [illegible]

B) $\Delta m = Zm_p - Nm$

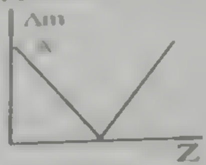
C) [illegible]

D) $\Delta m = M_{nucleus} + Zm_p - (A - Z)m$

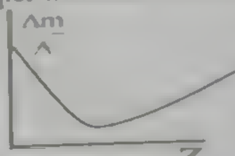
Q.58 Which of given graph between mass defect per nucleons and charge No. is correct



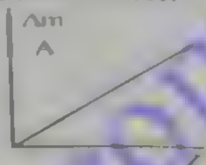
A)



B)



C)



D)

Q.59 An atom emit some radiation such that daughter nucleus is isotope of parent nucleus, the emitted radiation is

A) α

B) β

C) γ

D) 1α and 2β

Q.60 A bismuth nucleus emits a β-particle and a product polonium nucleus emits an α-particle according to equation ${}^{P}_{Q}B_i \longrightarrow {}^{R}_{S}Po \longrightarrow {}^{208}_{82}Pb$ which of given set of numbers correctly represents P, Q, R and S?

	P	Q	R	S
A	212	85	212	84
B	212	83	212	84
C	210	83	208	81
D	210	83	210	84

ANSWER KEY

1	A	11	A	21	C	31	D	41	D	51	B
2	D	12	B	22	A	32	C	42	D	52	D
3	B	13	A	23	D	33	A	43	C	53	C
4	D	14	C	24	D	34	A	44	C	54	C
5	B	15	B	25	D	35	B	45	A	55	A
6	A	16	A	26	D	36	A	46	A	56	D
7	A	17	C	27	A	37	D	47	B	57	C
8	A	18	D	28	B	38	C	48	D	58	C
9	A	19	B	29	B	39	A	49	C	59	D
10	C	20	C	30	A	40	C	50	C	60	B

EXPLANATORY NOTES

Q.1 Power= (Muscle)(Speed)

$P = F.v$

Muscle = Force

$\frac{1N}{dyne} = 10^5$

Q.2 The units of $\frac{c}{\lambda} = s^{-1}$

The units of $\frac{x}{\lambda} =$ Unitless

Q.3 $\%\ error = \frac{L.C}{n} \times 100 = \frac{0.1}{20} \times 100 = 0.5\%$

Q.4 $x = \frac{ab^2}{c^3} = 1\% + 2(13\%) + 3(2\%) = 33\%$

Q.5 Area of a-t graph=speed

$v = \frac{1}{2} \times 11 \times 10 = \frac{110}{2} = 55ms^{-1}$

Q.6 $S_{nth} = 10n - 5$

$S_{4th} = 35m$

$S_{3rd} = 25m$

$\frac{S_{4th}}{S_{3rd}} = \frac{35}{25} = \frac{7}{5}$

Q.7 Graph of vertically thrown upward body.

Q.8 $40^\circ + 50^\circ = 90^\circ$

if $\theta_1 + \theta_2 = 90^\circ \Rightarrow R_1 = R_2$

Q.9 $W = mgh$

$W = 60 \times 5 = 300 Nm.$

Q.10 $K.E = \frac{p^2}{2m} \Rightarrow \frac{p_1}{p_2} = \sqrt{\frac{m_1}{m_2}} = \sqrt{\frac{1}{9}} = \frac{1}{3}$

Q.11 $w = Fd = \frac{1}{2}mv^2$

K.E $\rightarrow$ same

Distance $\rightarrow$ same

Q.12 Loss in P.E= gain in K.E.

Q.13 Slope $= \frac{K.E}{Distance} = \frac{Nm}{m} = N$ (The time rate of change of momentum is called force.)

Q.14 $P = Fv$

$v = \frac{P}{F} = \frac{P}{mg}$

Q.15 $x = x_0 \sin \omega t$

[illegible]00 . (1 + 0.05)

$T = \frac{1}{50} = 0.02\,sec$

Q.16 $v = v_0\sqrt{1 - \frac{x^2}{x_0^2}}$

Here $x = \frac{x_0}{2}$

$v' = v_0\sqrt{1 - \frac{\left(\frac{x_0}{2}\right)^2}{x_0^2}}$

$v' = v_0\sqrt{3/2}$

Q.17 $T = 2\pi\sqrt{\frac{l}{a_{net}}}$

$F_{net} = w - F_e$

$ma = mg - qE$

$a_{net} = g - \frac{qE}{m}$

$\Rightarrow T = 2\pi\sqrt{\frac{l}{\left(g - \frac{qE}{m}\right)}}$

Q.18 $T = 2\pi\sqrt{\frac{m}{K_e}}$

In series combination

$K_e = \frac{(K_1K_2)}{K_1 + K_2}$

$T = 2\pi\sqrt{\frac{m(K_1 + K_2)}{(K_1K_2)}}$

Q.19 Time taken from mean to half of amplitude

$t = \frac{T}{12} = \frac{12}{12} = 1\,sec$

Q.20 $x_o w = x_o w^2$

$\frac{2\pi}{T} = 1$

$T = 2\pi = 6.28\,sec$

Q.21 Work = area of P-V graph

$w = \pi r^2$

$w = \pi\left(\frac{P_2 - P_1}{2}\right)\left(\frac{V_2 - V_1}{2}\right)$

$w = \frac{\pi}{4}(P_2 - P_1)(V_2 - V_1)$

Q.22 $PV = nRT$

$T = \frac{PV}{nR} = \frac{\text{work}}{nR} = \frac{\text{area under graph}}{nR}$

$T = \frac{\frac{1}{2}(P_o + 2P_o)(V_o)}{nR}$

$T = \frac{3P_oV_o}{2nR}$

Q.23 $\Delta Q = \Delta U + \Delta W$

$\Delta U = \Delta Q - \Delta W$

Q.24 $\Delta y = \frac{\lambda l}{d}$

Q.25 $F_{med} = \frac{F_{air}}{\varepsilon}$

Q.26 $F = \frac{kq^2}{r^2}$

For second orbit

$r_2 = 4r$

$F' = \frac{F}{16}$

Q.27 $E = \frac{kq}{r^2}$

$r_A < r_B$

$E_A > E_B$

Q.28 Incoming current = outgoing current

15A+3A=5A+I

I=18A-5A=13A

Q.29 $R_T \; x = \frac{R}{n}$

$R = nx$

$R' = nR = n(nx) = n^2x$

Q.30 $\frac{1}{r} = \frac{1}{1} + \frac{2}{4} + \frac{1}{2}$, $r = 0.5\,\Omega$

Q.31 $R = \rho \frac{l}{A}$

$R = \frac{\rho l^2}{V} \left(\because A = \frac{V}{L} \right)$

$R = \frac{\rho d l^2}{m} \left(\because V = \frac{m}{d} \right)$

$R \propto \frac{L^2}{m}$

$R_1 : R_2 : R_3 = \frac{5^2}{1} : \frac{3^2}{3} : \frac{1^2}{5} = 125 : 15 : 1$

Q.32 $\varepsilon = \frac{N\Delta\phi}{\Delta t}$

$\Delta\phi = \varepsilon \times \Delta t \qquad (\because N = 1)$

Q.33 $\varepsilon = \frac{N\Delta\phi}{\Delta t}$

$IR = \frac{N\Delta\phi}{\Delta t}$

$\frac{Q}{\Delta t} R = \frac{N\Delta\phi}{\Delta t}$

$Q = \frac{N\Delta\phi}{R}$

Q.34 $\varepsilon = \frac{N\Delta\phi}{\Delta t}$

$\varepsilon = \frac{3A_0B_0}{\Delta t}$

Q.35 $\varepsilon = \varepsilon_0 \cos 2\pi f t$

$\varepsilon = 10 \cos 2\pi \times 50 \times \frac{1}{600}$

$\varepsilon = 5\sqrt{3}$ volt

Q.36 $B = \mu_0 n I$

$B = 4\pi \times 10^{-7} \times \frac{10}{10^{-2}} \times 5$

$B = 4\pi \times 10^{-4} \times 5$

$B = 2\pi \times 10^{-3}\,T$

Q.37 $F = qvB \sin\theta$ other than $0°$ and $180°$ it gives non zero values

Q.38 $v = \frac{E}{B} = \frac{1500}{0.40} = 3.75\times10^{3}\,ms^{-1}$

Q.39 $F_c = F_B$ work done by centripetal force is zero

Q.40 $\frac{e}{m} = \frac{v}{Br}$

$r = \frac{mv}{Bq}$

$r' = \frac{2Vm}{B\frac{q}{2}}$

$r' = 4\left(\frac{vm}{Bq}\right)$

$r' = 4r$

Q.41 $\lambda = \frac{h}{\sqrt{2mqv}}$

$\frac{\lambda_e}{\lambda_p} = \sqrt{\frac{m_p}{m_e}}$

Q.42 $hf = \phi + K.E$

$h\frac{c}{\lambda} = 2.5eV + K.E$

$\frac{6.63\times10^{-34}\times3\times10^{8}}{4000\times10^{-10}} = 2.5eV + K.E$

$4.97\times10^{-19}J = 2.5eV + K.E$

$\frac{4.97\times10^{-19}}{1.6\times10^{-19}}eV = 2.5eV + K.E$

$K.E = 3.1eV - 2.5eV$

$K.E = 0.6eV$

Q.43 $r_n = n^2 r_1$

Q.44 $E_n = \frac{E_1}{n^2}$

$\frac{E_2}{E_3} = \frac{3^2}{2^2} = \frac{9}{4}$

Q.45 $Ve = \frac{hc}{\lambda}$

$h = \frac{Ve\lambda}{c}$

Q.46 Undecayed atoms $= \frac{1}{2^n}$

n = number of half lives

Undecayed atoms $= \frac{1}{2} = \frac{1}{8}$

Q.47 $N = N e^{[illegible]}$

$\frac{N}{20} = N e^{[illegible]}$

T = 16 days

Q.48 Reduced factor $= \frac{1}{2^n}$

$= \frac{1}{2^3}$

$= \frac{1}{8}$

Q.49 In fusion 0.1% of mass is converted into energy

Q.50 It happens due to increasing the reverse voltage above a certain voltage level when exceeds the break down voltage

Q.51 $V_p < V_N$

Q.52 In forward bias, potential barrier width and potential decreases.

Q.53 $f' = 2f_{(fundemetal)}$

Q.54 For forward, negative terminal is connected with n-side

Q.55 As circuit is forward based, it offer no resistances, so voltage across R is V

Q.56 No. of neutrons = atomic mass-atomic No (N=A-Z)

Q.57 Equation of mass defect is: mass defect = mass of constituents- mass of nucleus

$\Delta m = Zm_p + (A - Z)m_n - m_{nucleus}$

Q.58 Graph from book:

Mass defect per Nucleon First decreases than increases with respect to atomic no.

Q.59 When one $\alpha -$ Particle and two $\beta -$ Particles are emitted then mass of the daughter element will different but atomic No will be same

Q.60 $Bi \longrightarrow Po \longrightarrow Pb$ [illegible]

Practice Exercises

TOPIC WISE

TOPIC-1 MEASUREMENT

PRACTICE EXERCISE

TOPIC-WISE MCQ's

PHYSICAL QUANTITIES [illegible] NUMERICAL MAGNITUDE AND A PROPER UNIT

Q.1 **The velocity of a particle is given by:**

[illegible]

If v is measured in ms^{-1} and t is measured in s, the unit of:

A) a is $m\ s^{-1}$
B) [illegible]
C) b is $m\ s^{-1}$
D) a and b are same but that of c is different

Q.2 If [illegible], where x is the distance travelled by the body in kilometers while t is the time in seconds, then the units of b are:

A) k m/s
B) k m/s^2
C) k m s
D) k m s^2

Q.3 Which one of the following is not regarded as a fundamental quantity in physics?

A) Weight
B) Mass
C) Length
D) Time

Q.4 Which one of the following is not a unit of length?

A) angstrom
B) radian
C) micron
D) light year

Q.5 Which expression could be correct for the velocity 'v' of ocean waves in terms of 'ρ' the density of sea water, 'g' the acceleration of free fall, 'h' the depth of ocean and 'λ' the wavelength?

A) [illegible]
B) [illegible] $\rho g h$
C) $\sqrt{\frac{g}{h}}$
D) $\sqrt{\frac{g}{\rho}}$

Q.6 Characteristics for an ideal standard are

A) Variable and non-accessible
B) Invariable and non-accessible
C) Invariable and accessible
D) variable and accessible

Q.7 In the expressions below a is acceleration, F is force, m is mass, t is time, v is velocity. Which expression represents energy?

A) [illegible]
B) [illegible]
C) Fvt
D) $\frac{at^2}{2}$

Q.8 Which of the following expressions defines power?

A) Force × distance moved in the direction of force
B) Force ÷ velocity
C) work done ÷ time taken
D) work done × time taken

Q.9 One light year is equal to

A) 7.88 × [illegible] m
B) [illegible]
C) 9.46 × [illegible] m
D) 9.46 × 10^{15} k m

INTERNATIONAL SYSTEM OF UNITS, SI BASE UNITS OF PHYSICAL QUANTITIES, THEIR DERIVED UNITS

Q.10 SI units of gas constant are:
A) watt K^{-1} mol^{-1}
B) joule K^{-1} mol^{-1}
C) newton K^{-1} mol^{-1}
D) erg K^{-1} mol^{-1}

Q.11 The unit of permittivity of free space ε_o is:
A) coulomb/newton-meter
B) coulomb^2/(newton-m)^2
C) newton-m^2/coulomb^2
D) coulomb^2/(newton-m^2)

Q.12 The correct unit of thermal conductivity is:
A) joule m^{-1} sec^{-1} $(°C)^{-1}$
B) joule sec
C) joule m sec^{-1} $(°C)^{2}$
D) joule m^{-1} sec^{-1} $(°C)$

Q.13 Which of the following is a derived unit?
A) cd
B) A
C) kg m s^{-1}
D) mole

Q.14 Which of the following is not measured in the units of energy?
A) Couple × angle turned through
B) Force × Distance
C) Moment of inertia × (angular velocity)^2
D) Impulse × Time

Q.15 Units of magnetic flux are:
A) weber/metre
B) joule × coulomb/metre
C) newton × metre/ampere
D) tesla

Q.16 Steradian is the SI unit of
A) Plane Angle
B) Mass
C) Solid Angle
D) Force

Q.17 In the equation $\left(P + \frac{a}{V^2}\right)(V - b) = RT$, the SI unit of a is
A) N m^2
B) N m^4
C) N m^3
D) N m^{-2}

Q.18 Which is the derived quantity in SI units?
A) Electric current
B) Plane Angle
C) Electric charge
D) Amount of substance

Q.19 Which is not a base unit in SI:
A) kilogram
B) kelvin
C) joule
D) ampere

Q.20 Which one of the following is not a derived unit?
A) frequency
B) gravitational constant
C) Planck's constant
D) electric current

Q.21 The unit of Stefan's constant is:
A) W m^{-2} K^{-1}
B) W m K^{-4}
C) W m^{-2} K^{-4}
D) N m^{-2} K^{4}

Q.22 The SI unit of specific resistance is
A) ohm m^{-2}
B) ohm metre
C) kg ohm $metre^{-2}$
D) $(ohm\ m)^{-1}$

Q.23 Which of the following expressions does not have the second as its base unit?
A) $\frac{1}{\text{frequency}}$
B) $\sqrt{\frac{\text{Length}}{\text{Acceleration}}}$
C) Capacitance × resistance
D) $\frac{\text{Mass}}{\text{spring constant}}$

Q.24 **Solid angle is a**

A) Two dimensional angle
B) One dimensional angle
C) Three dimensional angle
D) All of these

Q.25 **What is the SI unit of electric field intensity?**

A) C m
B) A m^{-1}
C) V m^{-1}
D) N A

Q.26 The energy of the photon of light of frequency '*f*' is given by '*hf*', where '*h*' is the Planck **constant. What are the base units of 'h'?**

A) kg m s^{-1}
B) kg m^2 s^{-2}
C) kg m^2 s^{-1}
D) kg m^2 s^{-3}

Q.27 Which of the following pairs of units are both SI base units?

A) ampere, degree celsius
B) coulomb, degree celsius
C) ampere, kelvin
D) coulomb, kelvin

Q.28 Energy per unit volume represents

A) Pressure
B) Force
C) Thrust
D) Work

Q.29 Which one of the following quantities has a unit that can be expressed in terms of just **two different SI base units?**

A) Area
B) Current
C) Charge
D) Resistance

Q.30 If "P" is the momentum of an object of mass "m", the expression $\frac{P^2}{2m}$ **has base units identical to:**

A) Energy
B) Power
C) Force
D) Velocity

Q.31 The angle made by an area of a sphere equal to the square of its radius at its centre is

A) One degree
B) One revolution
C) One radian
D) One steradian

Q.32 1 pascal =

A) kg m s^{-2}
B) kg m^{-2} s^{-2}
C) kg m^{-1} s^{-2}
D) kg m^{-2} s^{-3}

Q.33 The unit of $\sqrt{\frac{l}{g}}$ is same as that of:

A) time
B) velocity
C) energy
D) force

Q.34 Which of the following pairs of electrical units are the units equivalent?

A) coulomb ; A s
B) pascal ; N s
C) farad ; C^{-1} V
D) volt ; J C^{-1}

PREFIXES AND SYMBOLS TO INDICATE DECIMAL, SUBMULTIPLES OR MULTIPLES OF BOTH BASE AND DERIVED UNITS

Q.35 What is the ration of giga (G) to nano (n) ?

A) exa
B) peta
C) tera
D) atto

example the prefix milli (m) represents 10^{-3}. Which of the following gives the ... represented by pico (p) and giga(G)?"

A) $10^{...}$

B) $10^{...}$

C)

D)

ERRORS AND UNCERTAINTIES

SYSTEMATIC ERROR AND RANDOM ERROR

Q.37 The uncertainty in a measurement may occur due to:

A) Limitation of an instrument

B) Natural variation of the object to be measured

C) Inadequate technique

D) All given in a, b and c

Q.38 Which experimental technique reduces the systematic error of the quantity being investigated?

A) Adjusting an ammeter to remove its zero error before measuring a current

B) Timing a large number of oscillations to find a period

C) Measuring the diameter of a wire repeatedly and calculating the average

D) All of these

Q.39 The measurement of a physical quantity may be subjected to random errors and to systematic errors.
Which statement is correct?

A) Random errors can be reduced by taking the average of several measurements

B) Random errors are always caused by the person taking the measurement.

C) A systematic error cannot be reduced

D) A systematic error results in a different reading each time the measurement is taken

FRACTIONAL UNCERTAINTY AND PERCENTAGE UNCERTAINTY

Q.40 The radius of a ball is (5.2 ± 0.2) cm. The percentage error in the volume of the ball is

A) 11%   C) 4%

B) 7%   D) 9%

Q.41 While measuring the acceleration due to gravity by a simple pendulum, a student makes a positive error of 1% in the length of the pendulum and a negative error of 3% in the value of time period. His percentage error in the measurement of g by the relation $g = 4\pi^2 (l/T^2)$ will be:

A) 2%   C) 4%

B) 7%   D) 10%

Q.42 An experiment measured quantities a, b, c and then x is calculated from ... If the percentage errors in a, b, c are $\pm1\%$, $\pm3\%$ and $\pm2\%$ respectively, the percentage error in x can be:

A) $\pm13\%$ C)

B)   D)

Q.43 If $x = a^n$, then fractional error $\frac{\Delta x}{x}$ is equal to:

A) $\pm\left(\frac{\Delta a}{a}\right)^n$
C) $\pm n\left(\frac{\Delta a}{a}\right)$
B) $\pm n \log_e \frac{\Delta a}{a}$
D) $\pm n \log \frac{\Delta a}{a}$

Q.44 The percentage errors in the measurement of mass and speed are 2% and 3% respectively. How much will be the maximum error in the estimate of kinetic energy obtained by measuring mass and speed?

A) 11%
C) 8%
B) 5%
D) 4%

Q.45 The time of 20 oscillations of the pendulum is found to be 20 sec. The percentage error in the time period is:

A) 0.25 %
C) 0.5 %
B) 0.75%
D) 1.0%

Q.46 The power loss P in a resistor is calculated using the formula $P = \frac{V^2}{R}$. The uncertainty in the potential difference V is 3% and the uncertainty in the resistance R is 2% what is the uncertainty in P?

A) 4%
C) 8%
B) 7%
D) 11%

Q.47 A thermometer can be read to an accuracy of $\pm 0.5\,^\circ C$. This thermometer is used to measure a temperature rise from 40°C to 100°C.
What is the percentage uncertainty in the measurement of the temperature rise?

A) 0.5%
C) 0.8%
B) 1.3%
D) 1.7%

ASSESSMENT OF TOTAL UNCERTAINTY IN THE FINAL RESULTS (UNDERSTANDING OF TOTAL ASSESSMENT ABOUT ADDITION AND SUBTRACTION, MULTIPLICATION AND DIVISION & POWER FACTOR)

Q.48 The resistance R of an unknown resistor is found by measuring the potential difference V across the resistor and the current I though it and using the equation $R = \frac{V}{I}$. The voltmeter reading has a 3% uncertainty and the ammeter reading has a 2% uncertainty. What is the uncertainty in the calculated resistance?

A) 1.5%
C) 3%
B) 5%
D) 6%

Q.49 An experiment is done to measure the resistance of a wire.
The current in the wire is $1.0 \pm 0.2\,A$ and the potential difference across the wire is $8.0 \pm 0.4\,V$.
What is the resistance of the wire and its uncertainty?

A) $(8.0 \pm 0.2)\,\Omega$
C) $(8 \pm 1)\,\Omega$
B) $(8.0 \pm 0.6)\,\Omega$
D) $(8 \pm 2)\,\Omega$

A mass 'm' has acceleration 'a'. It moves through a distance 's' in time 't'. The po... used in accelerating the mass is equal to the product of force and velocity. ... percentage uncertainties are

0.1% in m, 1% in a,

1.5% in s, 0.5% in t.

What is the percentage uncertainty in the average power?

A) 2.1% C) 2.6%

B) 3.1% D) 4.1%

ANSWER KEY

1	B	11	D	21	C	[illegible]	D	[illegible]	B
[illegible]	B	12	D	[illegible]	B	[illegible]	C	[illegible]	A
[illegible]	A	[illegible]	C	[illegible]	D	[illegible]	A	[illegible]	C
[illegible]	B	[illegible]	D	[illegible]	C	[illegible]	D	[illegible]	C
[illegible]	A	[illegible]	C	25	C	[illegible]	A	[illegible]	C
[illegible]	C	[illegible]	C	[illegible]	C	[illegible]	C	[illegible]	C
[illegible]	C	[illegible]	B	[illegible]	C	[illegible]	D	47	D
[illegible]	C	[illegible]	C	[illegible]	A	[illegible]	A	[illegible]	B
[illegible]	C	[illegible]	C	[illegible]	C	[illegible]	A	[illegible]	D
10	B	20	D	30	A	40	A	50	B

EXPLANATORY NOTES

Q.1 $v = at^2 + bt + c$

As v is in ms^{-1}, all other quantities [illegible]
ms^{-1}

Q.2 In equation, those quantities are added [illegible]

$x = bt^2$

$b = \frac{x}{t^2} = k\,ms$ [illegible]

Q.3 **Weight is not a basic quantity.**

Q.4 **radian is unit of angle**

Q.5 $v = \sqrt{g\lambda} \Rightarrow ms^{-1} = \sqrt{m\,s^{-2}}$ [illegible]

Q.6 Fact

Q.7 $Fvt \Rightarrow N \times ms^{-1} \times s = Nm = J$

Q.8 $Power = \frac{work}{time}$

Q.9 $S = vt \Rightarrow 3.0 \times 10^8 \times 365 \times 24 \times 60 \times 60 = 9.46 \times 10$ [illegible]

Q.10 $PV = nRT$

$R = \frac{PV}{nT} = \frac{Nm^{-2}\,m^3}{mol\,k} = \frac{Nm}{mol\,k}$ [illegible]

Q.11 $F = \frac{1}{4\pi\varepsilon_o}\frac{q_1 q_2}{r^2}$

$\varepsilon_o = \frac{1}{4\pi F}\frac{q_1 q_2}{r^2} = \frac{C^2}{Nm^2} = C^2N^{-1}m^{-2}$

Q.12 $Q = \frac{KA(T_1 - T_2)t}{L} \Rightarrow K = \frac{QL}{A(T_1 - T_2)t}$ [illegible]

Q.13 Except "kg m s^{-1}" all other are basic units

Q.14 Except "Impulse × time" all other are equal to units of energy

$W = \tau\theta$

$K.E = \frac{1}{2}I\omega^2$

$W = Fd$

Q.15 $\phi = BA$ [illegible] $\frac{Nm}{Am}$ [illegible] $\frac{Nm}{A}$

Q.16 **S.I unit of solid angle is steradian.**

Q.17 All factors which are being added must have same units. [illegible] requirement 'a' must have unit N m^4.

$P = \frac{a}{V^2} \Rightarrow a = PV^2 = \frac{N}{m^2}m^6 = N\,m^4$

Q.18 ... quantity

Q.19 ... except 'Joule'

Q.20 Electric current is a basic quantity.

Q.21 ... W m^{-2} k^{-4}

Q.22 $\rho = \frac{RA}{l} = \Omega\ m^2\ m^{-1} = \Omega\ m$

Q.23 $\frac{\text{Mass}}{\text{Spring constant}} = \frac{kg}{kg\,s^{-2}} = s^2$. so this is '$s^2$'.

Q.24 Solid angle is a three dimensional angle.

Q.25 $E = \frac{\Delta V}{\Delta r} = V\,m^{-1}$

Q.26 $E = hf \Rightarrow h = \frac{E}{f} = kg\,m^2 s^{-2} s = kg\,m^2 s^{-1}$

Q.27 Ampere, kelvin are both S.I base units.

Q.28 $\frac{E}{V} = \frac{mgh}{V} = \frac{kg\,m^2 s^{-2}}{m^3} = kg\,m^{-1} s^{-2}$ = Pressure

Q.29 $Q = I \times t$

$= \text{ampere} \times \text{sec}$

Q.30 $\frac{P^2}{2m} = \frac{N^2 s^2}{kg} = kg\,m^2 s^{-2}$

Q.31 If $A = r^2$

$\theta = 1\,sr$

Q.32 $P = F/A = kg\,m^{-1} s^{-2}$

Q.33 $T = 2\pi\sqrt{\frac{l}{g}}$

Q.34 $V = \frac{W}{q} = \frac{J}{C} = JC^{-1}$

Q.35 $\frac{\text{giga}}{\text{nano}} = \frac{10^9}{10^{-9}} = 10^{18}$ (exa)

Q.36 Giga 10^9 and pico 10^{-12}.

Q.37 Causes of uncertainty.

Q.38 A Zero error is a systematic error.

Q.39 Remedy of random error is taking the average of several measurements.

Q.40 Percentage error in radius = $\frac{0.2}{5.2} \times 100 = 3.8\%$

Percentage error in volume = $\frac{4}{3}\pi r^3 = 3.8\% \times 3 \approx 11\%$

Q.41 $g = 4\pi^2 \frac{\ell}{T^2} = \%\ell + 2(\%T) = 1\% + 6\% = 7\%$

Q.42 $1\% + (3\% \times 2) + (2\% \times 3) = \pm 13\%$

Q.43 $a^n = x \Rightarrow \frac{\Delta x}{x} = \pm n \frac{\Delta a}{a}$

Q.44 $K.E = \frac{1}{2}mv^2 = 2\% + (3\% \times 2) = 2\% + 6\% = 8\%$

Q.45 $\%\text{error in time} = \frac{\text{L.C}}{\text{No. of vibration}} \times 100 = \frac{0.1}{20} \times 100 = 0.5\%$

Q.46 $P = \frac{V^2}{R}$

%age uncertainty in

$P\% = 2(V\%) + R\% = 2 \times 3\% + 2\% = 8\%$

Q.47 $\%\text{age uncertainty} = \frac{\text{L.C}}{\text{measused value}} \times 100$

$$\left(\frac{0.5}{40} \times 100\right) + \left(\frac{0.5}{100} \times 100\right) = 1.25\% + 0.5\% = 1.75\%$$

Q.48 % age uncertainty in "R"

$= V\% + I\% = 3\% + 2\% = 5\%$

Q.49 $R = \frac{V}{I} = \frac{8.0 \pm 0.4}{1.0 \pm 0.2}$

$R = 8\ \Omega$

$\%\text{age "U" in } V = \frac{0.4}{8} \times 100 = 5\%$

$\%\text{age U in } I = \frac{0.2}{1} \times 100 = 20\%$

$\%\text{U in } R = 25\%$

$R = 8\ \Omega \pm 25\% \text{ of } 8\ \Omega$

$R = 8\ \Omega \pm \frac{8}{100} \times 25$

$R = (8 \pm 2)\ \Omega$

Q.50 $P = Fv$

$P = ma \times \frac{s}{t} = m\% + a\% + s\% + t\% = 0.1\% + 1\% + 1.5\% + 0.5\%$

$P\% = 3.1\%$

Q.1 **Force in terms of base units is expressed as**
A) $kg\ ms^{-2}$
B) $kg\ m^2s^{-2}$
C) $kg\ m^2s^{-3}$
D) None of these

Q.2 Light year is a measure of
A) Distance
B) Time
C) Intensity of light
D) Velocity

Q.3 **The units of E in $E=mc^2$ are**
A) $kg\ m\ s^{-2}$
B) N m s
C) $kg\ m^2\ s^{-2}$
D) Both B and C

2010

Q.4 **Which one is the highest power multiple?**
A) Giga
B) Tera
C) Mega
D) Deca

Q.5 **SI unit of charge is _______.**
A) Ampere
B) Volt
C) Coulomb
D) Calorie

2013

Q.6 **Name the quantity which can be measured by using base unit '$kg\ m^2s^{-3}$':**
A) Weight
B) Pressure
C) Power
D) Work

Q.7 **The wavelength 'λ' of a wave depends on the speed 'v' of the wave and its frequen- Decide which of the following is correct?**
A) $f = \frac{v}{\lambda}$
B) $f = v\lambda$
C) $f = \frac{\lambda}{v}$
D) $f = v\lambda^{-2}$

2014

Q.8 **The formula for electric field strength is E= F/Q, where E is electric field streng force and Q is charge. Which of the following options gives the correct base ur electric field strength?**
A) $kgms^{-3}A^{-1}$
B) $kg^2m^{-1}s^2A$
C) $kgs^{-2}A^{-2}$
D) $m^2s^{-1}A^{-1}$

Q.9 **Which set of the prefixes give values in increasing order?**
A) Pico, Mega, Kilo, Tera
B) Pico, Micro, Mega, Giga
C) Tera, Pico, Micro, Kilo
D) Giga, Kilo, Mill, Nano

2015

Q.10 **The unit of temperature in base unit is**
A) Celsius
B) Degree
C) Kelvin
D) Fahrenheit

Q.11 **Magnetic field strength is measured in:**
A) Wb.m
B) Wb/m^2
C) Wbm^2
D) Wb

2016

Q.12 **The unit for electric charge is Coulomb and one Coulomb in terms of bas equivalent to**
A) Am
B) Js^{-1}
C) As
D) C

[illegible]

Q.13 The quantities which can be measured accurately are called

A) Base Quantities
B) Derived Quantities
C) Physical Quantities
D) Supplementary Quantities

Q.14 An observer notes reading of a scale from different angles (parallax) while measuring the length of wire, what kind of error can occur?

A) Systematic Error
B) Zero Error
C) Precised Error
D) Random Error

[illegible] 2017

Q.15 Which of the following is a supplementary physical quantity?

A) Radian
B) Steradian
C) Both "A" and "B"
D) None

[illegible]

Q.16 The different magnitudes of same physical quantities are measured by comparing them to

A) available scale
B) [illegible]
C) each other
D) [illegible]

Q.17 Force is derived quantity, its derived unit can be expressed in terms of the base units as

A) $kmgs^{-2}$
B) $kgcms^{-2}$
C) kmg^2s^2
D) $kmgs^2$

[illegible]

Q.18 The diameter of a wire is measured by using a micrometer screw gauge with least count of 0.01 mm, then which of the following readings will be correct?

A) 0.067 cm
B) 0.0067 mm
C) [illegible] cm
D) [illegible].70 cm

Q.19 Percentage un-certainty in length and width of a rectangle is 2% and 3%. The total un-certainty in area of that rectangle is?

A) 1.5%
B) [illegible]
C) 6%
D) 1%

Q.20 The unit of magnetic flux density is the tesla, 'T', it can also be expressed as

A) [illegible]
B) [illegible]
C) [illegible]
D) [illegible]

ANSWER KEY

1	A	11	B
2	A	12	C
3	C	13	C
4	B	14	D
5	C	15	D
6	C	16	B
7	A	17	A
8	A	18	A
9	B	19	B
10	C	20	D

EXPLANATORY NOTES

Q.1 F = ma

$= kg\frac{m}{s^2} = kgms^{-2}$

Q.2 Light year is a measure of distance.
It is defined as the distance travelled by light in one year

Q.3 $E = mc^2$

$= 1kg(ms^{-1})^2 = kgm^2s^{-2}$

Q.4 "Tera" is the highest power multiple.

Q.5 SI unit of charge is coulomb.

Q.6 $P = \frac{W}{t} = \frac{J}{s} = \frac{Nm}{s} = \frac{kgm^2}{s^3}$

Q.7 $v = f\lambda \Rightarrow f = \frac{v}{\lambda}$

Q.8 $E = \frac{F}{Q} \Rightarrow \frac{kgm}{s^2C} = \frac{kgm}{As^3} = kgms^{-3}A^{-1}$

Q.9 Pico = 10^{-12}, Micro = 10^{-6}, Mega = 10^{6}, Giga = 10^{9}

Q.10 Temperature = T= Unit (S.I) = Kelvin

Q.11 $B = T = \frac{Wb}{m^2}$

Q.12

Q = It

1C = As

Q.13 The quantities which can be measured accurately are called physical quantities.

Q.14 An observer notes reading of a scale from different angles (parallax) while measuring length of wire, that kind of error is called random Error

Q.15 Supplementry physical quantities are plane angle and solid angle.

Q.16 The different magnitudes of same physical quantities are measured by comparing standard size.

Q.17 $F = ma = kg\frac{m}{s^2} = kgms^{-2}$

Q.18 Least count = 0.01mm = 0.001 cm
The following reading is 0.067cm

Q.19 Total uncertainty in area = L% + W% = 2% + 3% = 5%

Q.20

TOPIC-2 MOTION AND FORCE

PRACTICE EXERCISE

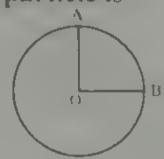
TOPIC-WISE MCQ's

DISPLACEMENT, DISTANCE, SPEED, VELOCITY AND ACCELERATION

Q.1 The engine of a car produces an acceleration of 6 m s^{-2} in the car. If this car pulls another car of the same mass, then the acceleration would be

A) 6 m s^{-2}
B) 12 m s^{-2}
C) 3 m s^{-2}
D) 1.5 m s^{-2}

Q.2 A particle starts from center O towards A then moves along AB and stop at B. if R = 100m then displacement of the particle is



A) 100 m
B) $\frac{100}{\sqrt{2}}$ m
C) $100\sqrt{2}$ m
D) None

Q.3 The instantaneous acceleration is the limit of average acceleration as $\Delta t \to 0$ is given by

A) $\vec{a}_{ins} = \lim_{\Delta t \to 0} \frac{\Delta \vec{d}}{\Delta t}$
B) $\vec{a}_{ins} = \lim_{\Delta t \to 0} \frac{\Delta \vec{v}}{\Delta t}$
C) $\vec{a}_{ins} = \lim_{\Delta t \to 0} \frac{\Delta t}{\Delta v}$
D) $\vec{a}_{ins} = \lim_{\Delta t \to 0} \frac{\Delta a}{\Delta t}$

Q.4 If an object is moving with constant velocity of 20ms^{-1} towards north then its acceleration will be

A) 5 m s^{-2}
B) 9 m s^{-2}
C) 10 m s^{-2}
D) 0 m s^{-2}

Q.5 The retardation is defined as

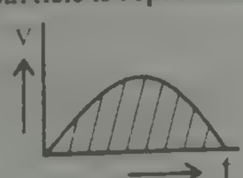
A) increase in velocity per unit time
B) decrease in speed per unit time
C) decrease in velocity per unit time
D) increase in speed per unit time

Q.6 A sledge of mass 25 kg is pulled across level ground with a horizontal force of 60 N. The constant force of friction is 20 N. What is the acceleration of the sledge?

A) 0.5 m s^2
B) 2 m s^2
C) 1.6 m/s^2
D) 0.2 m/s^2

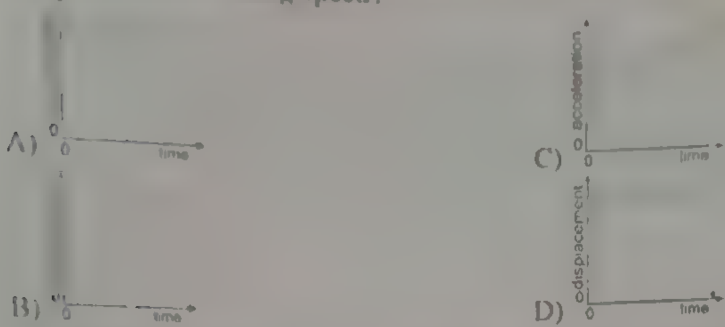
VELOCITY-TIME GRAPH

Q.7 The Figure shows the velocity time graph of a one dimensional motion. Which of the following characteristic of the particle is represented by the shaded area?

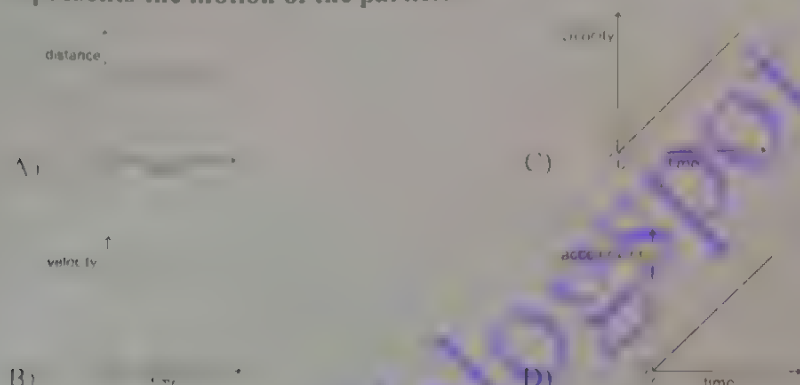


A) Distance covered
B) Momentum
C) Speed
D) Acceleration

Which graph represents the motion of a car that is travelling along a straight ro... a uniformly increasing speed?



Q.9 A particle is moving in a straight line with uniform acceleration. Which gr... represents the motion of the particle?



EQUATIONS OF MOTION

Q.10 A body moves from rest with a constant acceleration of $5\,m/s^2$. Its instantaneous sp... (in m/s) at the end of 10 sec is

A) 50
B) 2
C) 5
D) 0.5

Q.11 If a body starts from rest and travels 120 *cm* in the 6^{th} second, then what ... acceleration

A) 0.20 m/s^2
B) 0.218 m/s^2
C) 0.027 m/s^2
D) 0.03 m/s^2

Q.12 If a car at rest accelerates uniformly to a speed of 144 *km/h* in 20 s. Then it cov... distance of

A) [illegible] m
B) [illegible] m
C) 400 m
D) 2880 m

Q.13 A stone is shot straight upward with a speed of 20 *m/sec* from a tower 200 *m* hi... speed with which it strikes the ground is approximately

A) 60 m/sec
B) [illegible]
C) 65 m/sec
D) [illegible]

Q.14 An object is projected upwards with a velocity of 100 [illegible]. It will strike the ground after (approximately)

[illegible]

NEWTON'S LAWS OF MOTION

Q.15 If the force acting on a body is doubled, then acceleration becomes

A) Half
B) One fourth
C) Doubled
D) Constant

Q.16 When force of 1 N is applied on a body of mass 100 g then the acceleration would be

A) 5 m s^{-2}
B) [illegible]
C) 0.5 m s^{-2}
D) 0.1 m s^{-2}

Q.17 A mass of 10 kg moves with an acceleration of 10 m s^{-2}, the force on it is

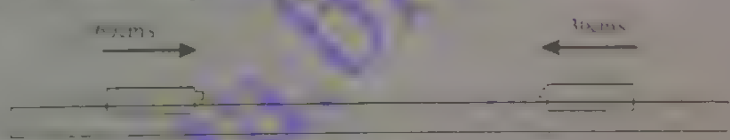
A) 5 N
B) 50 N
C) 100 N
D) 25 N

MOMENTUM AND LAW OF CONSERVATION OF MOMENTUM

Q.18 When a force of 4 N acts on a mass of 2 kg for a time of 2 sec, what is the rate of change of momentum?

A) 2 kg m s^{-2}
B) 8 kg m s^{-2}
C) 4 kg m s^{-2}
D) 16 kg m s^{-2}

Q.19 Two equal masses travel towards each other on a frictionless air track at speeds of 60 cm s^{-1} and 30 cm s^{-1}. They stick together on impact.



What is the speed of the masses after impact?

A) 15 cm s^{-1}
B) 20 cm s^{-1}
C) 30 cm s^{-1}
D) 45 cm s^{-1}

Q.20 Which is a statement of the principle of conservation of momentum?

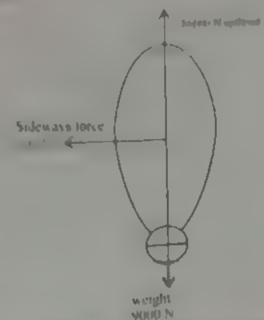
A) A force is equal to the rate of change of momentum of the body upon which it acts
B) In a perfectly elastic collision, the relative momentum of the bodies before impact is equal to their relative momentum after impact
C) The momentum of a body is the product of the mass of the body and its velocity
D) The total momentum of a system of interacting bodies remains constant, provided no external force acts

FORCE AND RATE OF CHANGE OF MOMENTUM

Q.21 The average force necessary to stop a hammer with 25 N s momentum in 0.05 s expressed in 'N' is

A) 500
B) [illegible]
C) 125
D) [illegible]

Q.22 A balloon is acted upon by three force, weight, upthrust and sideway force du... wind as shown in the diagram



What is the vertical component of the resultant force on the balloon?

A) 500 N
B) 10000 N
C) 1000 N
D) 10500 N

IMPULSE AND $I = F \times t = mv_f - mv_i$

Q.23 A cricket ball of mass 0.5 kg strikes a bat normally with a velocity of 30 m s... rebounds with a velocity of 20 m s^{-1} in the opposite direction. The impulse of the f... exerted by the ball on the bat is

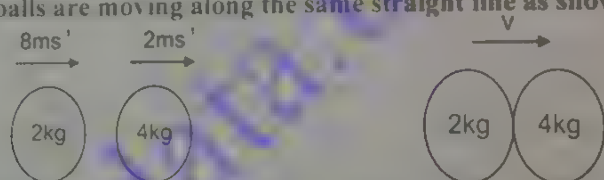
A) 0.5 N s
B) 25 N s
C) 1.0 N s
D) 50 N s

Q.24 A force of 6 N acts on a mass of 1kg which acquire velocity of 30ms^{-1}. The time... which the force acts is

A) 26 s
B) 5 s
C) 6 s
D) 2 s

ELASTIC AND IN-ELASTIC COLLISIONS

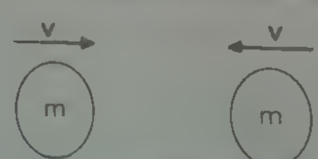
Q.25 A ball of mass 2 kg travelling at 8 ms^{-1} strikes a ball of mass 4 kg travelling at 2 ms^{-1}. Both balls are moving along the same straight line as shown



After collision, both balls move at the same velocity v. What is the magnitude of velocity v?

A) 4 ms^{-1}
B) 5 ms^{-1}
C) 6 ms^{-1}
D) 8 ms^{-1}

Q.26 Two similar spheres, each of mass m and travelling with speed v, are moving tow... each other.



The spheres have a head on elastic collision. Which statement is correct?

A) The spheres stick together on impact
B) The total kinetic energy after impact is mv^2
C) The total kinetic energy before impact is zero
D) The total momentum before impact is 2 mv

Q.27 Two railway trucks of masses m and 3m move towards each other in opposite directions with speeds 2v and v respectively. These trucks collide and stick together.
What is the speed of the trucks after the collision?

A) $\frac{v}{4}$ C) v

B) $\frac{v}{[illegible]}$ D) $\frac{5v}{4}$

PROJECTILE MOTION AND ITS APPLICATIONS

Q.28 A handball is tossed vertically upward with a velocity of 19.6 meters per second. **Approximately how high will it rise?**

A) 15 m C) 20 m

B) 25 m D) 30 m

Q.29 Which shows the correct relation between time of flight T and maximum height H?

A) $H = \frac{gT^2}{8}$ C) $H = \frac{8g}{T^2}$

B) $H = \frac{8T^2}{g}$ D) $H = \frac{8}{gT^2}$

Q.30 At maximum height on the trajectory which of projectile becomes zero

A) acceleration C) vertical velocity

B) velocity D) horizontal velocity

Q.31 Time taken by a projectile to reach maximum height is t =

A) $\frac{v \sin\theta}{2g}$ C) $\frac{v_i \sin\theta}{g}$

B) $\frac{v_i \sin 2\theta}{g}$ D) $\frac{2v_i \sin\theta}{g}$

Q.32 Two projectiles are projected at angle of 20^0 and 70^0 with same velocity which one have longer range

A) Which is fired at 20^0 C) Both have same range

B) Which is fired at 70^0 D) none of these

Q.33 The path followed by a projectile is known as its

A) range C) trajectory

B) cycle D) height

Q.34 A projectile is launched at point O and follows the path OPQRS, as shown. Air resistance may be neglected.

Which statement is true for the projectile when it is at the highest point Q of its path?

A) The horizontal component of the projectile's acceleration is zero

B) The horizontal component of the projectile's velocity is zero

C) The kinetic energy of the projectile is zero

D) The momentum of the projectile is zero

MOMENT OF FORCE OR TORQUE AND USE OF TORQUE

Q.35 If the position vector r and Force F lies in x-z plane. Then direction of torque is
A) Along y-axis
B) Along z-axis
C) Along x-axis
D) Along x-y plane

Q.36 If a nut and bolt are difficult to turn, it may be easier to turn the nut by using a longer spanner. This is because the longer spanner gives:
A) A larger moment of force
B) Less friction
C) A smaller moment of force
D) More friction

Q.37 It is easier to turn a steering wheel with both hands than with a single hand because
A) Accelerating force increases on the wheel
B) Two hands provide firm grip
C) Two forces act on the wheel
D) Couple acts on the wheel

Q.38 If direction of the applied force $\vec{F}$ is reversed then:
A) The magnitude of torque remains unchanged
B) There is change in magnitude and direction of the torque
C) The magnitude and direction of the torque remains constant
D) The magnitude of torque remains same but the direction reverses

Q.39 The direction of the torque $\vec{\tau} = \vec{r} \times \vec{F}$ is determined by:
A) Left hand rule
B) Head to tail rule
C) Knowing the direction of $\vec{r}$
D) Right hand rule

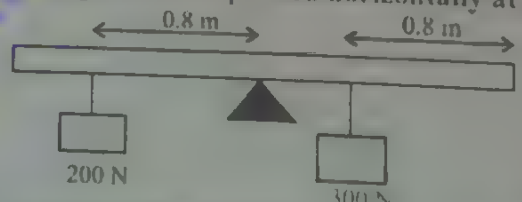
Q.40 Torque produced by a force depends upon:
A) Magnitude of the force and angular velocity
B) Magnitude of the force and displacement
C) Magnitude of the force and moment arm
D) Force and acceleration of the body

Q.41 If force applied makes an angle 'θ' with its position vector r relative to point O, then the torque will be
A) $\tau = rF \cos\theta$
B) $\tau = rF$
C) $\tau = rF \sin\theta$
D) $\tau = 0$

EQUILIBRIUM

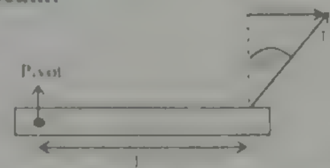
Q.42 What is not true for two forces that give rise to a couple?
A) They act in opposite directions
B) They both act at the same point
C) They both act on the same body
D) They both have the same magnitude

Q.43 A rigid uniform bar of length 2.4 m is pivoted horizontally at its mid point.



Weights are hung from two points of the bar as shown in the diagram. To maintain horizontal equilibrium, a couple is applied to the bar. What is the torque and direction of this couple?
A) 40 N m clockwise
B) 80 N m clockwise
C) 40 N m anti-clockwise
D) 80 N m anti-clockwise

Q.44 A force F is applied to a beam at a distance "d" from pivot. The force at an angle θ to a line perpendicular to the beam.

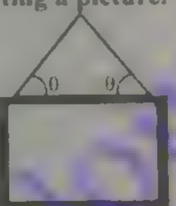


Which combination will cause the largest turning effect about the pivot.

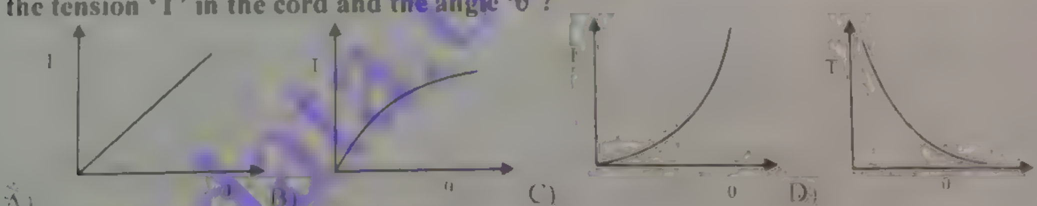
	F	d	θ
A)	Large	Large	Large
B)	Large	Large	Small
C)	Small	Small	Large
D)	Small	Large	Small

Q.45 When first condition of equilibrium is satisfied, the body has
A) No linear acceleration
B) Rotational equilibrium
C) No angular acceleration
D) None of these

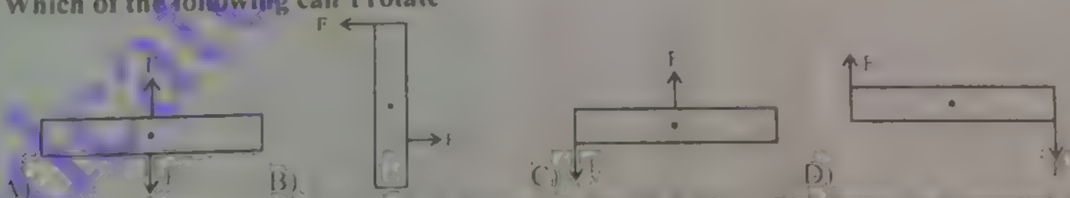
Q.46 The diagram shows a cord supporting a picture.



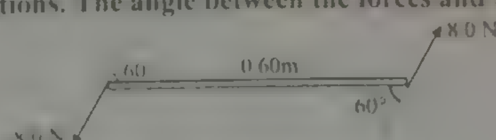
Which of the graph shown in the figure correctly represents the relationship between the tension 'T' in the cord and the angle 'θ'?



Q.47 Which of the following can't rotate



Q.48 Two 8.0 N forces act at each end of a beam of length 0.60 m. The forces are parallel and act in opposite directions. The angle between the forces and the beam is 60°.

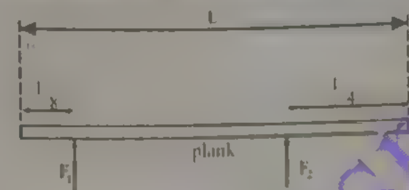


What is the torque of the couple exerted on the beam?
A) 2.4 N m
B) 4.2 N m
C) 4.8 N m
D) 9.6 N m

Q.49 The torque due to couple as shown in figure is

A) 0.866 N m
B) 1 N m
C) 2 N m
D) 0.5 N m

Q.50 A heavy uniform plank of length L is supported by two force F_1 and F_2 at points distance $\frac{L}{8}$ and $\frac{L}{4}$ from its ends as shown in the diagram. What is the ratio of F_1 to F_2?



A) 2 : 5
B) 3 : 5
C) 5 : 8
D) 2 : 3

ANSWER KEY

1	C	11	B	21	A	31	C	41	C
2	A	12	C	22	C	32	C	42	B
3	B	13	C	23	B	33	C	43	A
4	D	14	C	24	B	34	A	44	B
5	C	15	C	25	A	35	A	45	A
6	C	16	B	26	B	36	A	46	D
7	A	17	C	27	A	37	D	47	A
8	A	18	C	28	C	38	D	48	B
9	C	19	A	29	A	39	D	49	C
10	A	20	D	30	C	40	C	50	D

EXPLANATORY NOTES

Q.1 [illegible]

Q.2 Displacement is the shortest distance between initial and final positions of the body

Q.3 [illegible]

Q.4 Since velocity is constant so acceleration is zero.

Q.5 Definition of retardation.

Q.6 $F - f = ma$

$\frac{60-20}{25} = a \Rightarrow a = 1.6\ m/s^2$

Q.7 Area under v-t graph represents distance covered by the body.

Q.8 As velocity of an object is increasing uniformly so it's acceleration is constant.

Q.9 When velocity of an object change equally in equal interval of time then it is called uniform acceleration.

Q.10 $v = u + at \Rightarrow v = 0 + 5 \times 10 = 50\ m/s$

Q.11 $S_n = u + \frac{a}{2}(2n-1) \Rightarrow 1.2 = 0 + \frac{a}{2}(2\times 6 - 1)$

$\Rightarrow a = \frac{1.2 \times 2}{11} = 0.218\ m/s^2$

Q.12 Here $v = 144\ km/h = 40 m/s$

$v = u + at \Rightarrow 40 = 0 + 20 \times a \Rightarrow a = 2\ m/s^2$

$S = \frac{1}{2}at^2 = \frac{1}{2} \times 2 \times (20)^2 = 400\ m$

Q.13 Speed of stone in a vertically upward direction is $20 m/s$. So for vertical downward motion we will consider $u = -20\ m/s$

$v^2 = u^2 + 2gh = (-20)^2 + 2 \times 9.8 \times 200 = 4320\ m^2/s^2$

$\therefore v = 65\ m/s$

Q.14 Time of flight $= \frac{2u}{g} = \frac{2 \times 100}{10} = 20$ sec

Q.15 $F = ma \Rightarrow a \propto F$

Q.16 $a = \frac{F}{m} = \frac{1}{0.1} = 10\ m\ s^{-2}$

Q.17 [illegible]

Q.18 Rate of change of momentum is equal to applied force

So, $F = \frac{\Delta p}{\Delta t}$

Q.19

$$(m)(60) + m(-30) = (m+m)v$$

Q.20 Statement of law of conservation of momentum.

Q.21

$$F = \frac{\Delta p}{t} = \frac{25}{0.05} = 500\text{ N}$$

Q.22 Since forces are antiparallel

$$F = F_{[illegible]} - F_{[illegible]}$$

So $= 10000 - 9000$

$$F = 1000\text{ N}$$

Q.23 Impulse=change in momentum

$$I = mu - m(-v)$$

$$= m(u+v) = 0.5\times(30+20) = 25\text{ N s}$$

Q.24 $F = \frac{\Delta p}{t}$

$$t = \frac{mv}{F} = \frac{1\times 30}{6}$$

$$t = 5\text{s}$$

Q.25 For inelastic collision, momentum is still conserved.

Momentum before collision = momentum after collision

$$m_1u_1 + m_2u_2 = (m_1 + m_2)v$$

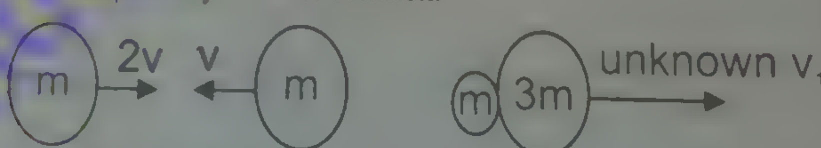
$$(2)(8) + (4)(2) = (2+4)v$$

$$v = 4\text{ ms}^{-1}$$

Q.26 Kinetic energy is conserved for elastic collision.

$$\frac{1}{2}mv^2 + \frac{1}{2}mv^2 = mv^2$$

Q.27 This is a perfectly inelastic collision.



$$m(2v) + 3m(-v) = (m+3m)v_1$$

$$-mv = 4mv_1$$

Q.28 [illegible]

Q.29 $H = \frac{v_i^2 \sin^2\theta}{2g}$

$H = \frac{4g}{4g}\,\frac{v_i^2 \sin^2\theta}{2g}$

$H = \left(\frac{2v_i \sin\theta}{g}\right)^2 \times \frac{g}{8}$

$H = \frac{gT^2}{8}$

Q.30 At maximum height projectile have minimum velocity as $v_y = 0$

Q.31 $T = \frac{v_i \sin\theta}{g}$ is the time taken to reach maximum height

Q.32 For complementary angles ranges are same.

$\theta_1 + \theta_2 = 90^\circ$

Q.33 Path followed by projectile is known as its trajectory.

Q.34 In projectile motion, horizontal component of velocity always remain same so acceleration along horizontal is zero.

Q.35 Torque is always perpendicular to the plane containing $\vec{r}$ and $\vec{F}$.

Q.36 $\tau = \ell F \Rightarrow \tau \propto \ell$

Q.37 Couple acts on the wheel and makes easier to turn wheel.

Q.38 $\vec{\tau} = \vec{r} \times \vec{F}$

If $\vec{F}$ is reserved

$\vec{\tau} = \vec{r} \times (-\vec{F})$

$\vec{\tau}$ is reversed but magnitude remain same.

Q.39 Direction of torque is determined by R.H.R.

Q.40 $\tau = \ell F$, F = Force, ℓ = Moment arm

Q.41 $\tau = rF\sin\theta$

Q.42 In couple forces acts on two different points.

Q.43

Clockwise moment = 300×0.4=120 N m

Anticlockwise moment = 200×0.8=160 N m

[illegible] an additional 40 Nm of clockwise moment will balance the bar

Q.44 $\tau = rF\cos\theta$

So we have large torque

If r is larger

F is larger and θ is small

Q.45 $F = ma$

$F = 0$

$a = 0$

Q.46

Fig

$T\sin\theta + T\sin\theta = W$

$2T\sin\theta = W$

$$T = \frac{W}{2\sin\theta}$$

$$T \propto \frac{1}{\theta}$$

Q.47 Forces are acting on pivot

Q.48 Couple = force × perpendicular distance

$$= (8.0) \times (0.60\sin 60°) = 4.2\ \text{N m}$$

Q.49 Torque due to couple = $F \times \ell\cos 60° = 2 \times 2 \times \frac{1}{2} = 2\ \text{N m}$

Q.50 $r_1 = \frac{L}{2} - \frac{L}{8} = \frac{3L}{8}$

$r_2 = \frac{L}{2} - \frac{L}{4} = \frac{L}{4}$

$\tau_1 = \tau_2$

$r_1F_1 = r_2F_2$

$$\frac{F_1}{F_2} = \frac{r_2}{r_1} = \frac{L}{4} \times \frac{8}{3L} \Rightarrow \frac{F_1}{F_2} = \frac{8}{12} = \frac{4}{6} = \frac{2}{3}$$

PAST PAPER MCQ's (2008-2019)

2008

Q. 1 The vertical velocity of ball thrown upward __________ with time.
A) Decreases linearly
B) Remains constant
C) Doubles
D) Decreases parabolically

Q. 2 An __________ missile is called a ballistic missile.
A) Un-powered and guided
B) Un-guided and powered
C) Powered and guided
D) Un-powered and un-guided

2009

Q. 3 If the body is rotating with uniform angular velocity, then its torque is:
A) Zero
B) Clockwise
C) Maximum
D) Remains the same

Q. 4 A body is moving with an initial velocity of 2 kms^{-1}. After a time of 50 secs its velocity becomes 1.5 kms^{-1}. Its acceleration will be:
A) 30 $m\ s^{-2}$
B) 40 $m\ s^{-2}$
C) 20 $m\ s^{-2}$
D) 10 $m\ s^{-2}$

Q. 5 In elastic collision, when a massive body collides with light body at conditions $m_1 >> m_2$ and $v_2 = 0\ ms^{-1}$, then the change in velocity will be written as:
A) $v_1' = -v_1$; $v_2' = v$
B) $v_1' = v_1$; $v_2' = 0$
C) $v_1' = v_1$, $v_2' = 2v_1$
D) $v_1' = -v_1$, $v_2' = 0$

Q. 6 What is torque 'τ' in a circular motion?
A) $\tau = mr^2\pi$
B) $\tau = mr^2\alpha$
C) $\tau = mr\alpha$
D) $\tau = mr^2/\alpha$

2010

Q. 7 The horizontal range of a projectile, at a certain place, is completely determined by
A) The angle of projection
B) The initial velocity of projection
C) The mass of the projectile
D) Speed and mass of the projectile

Q. 8 If a force of 12N is applied on a body and its momentum is changed form 60 $kgms^{-1}$ to 36 $kg\ ms^{-1}$, then find the time during which this force acts:
A) 1 second
B) 2 seconds
C) 12 seconds
D) 24 seconds

Q. 9 For a body to be in complete equilibrium
A) Linear acceleration is zero
B) Angular acceleration is zero
C) Linear acceleration is zero but angular acceleration is not zero
D) Linear acceleration and angular acceleration both should be zero

Q. 10 If length of a spanner is '*l*' and a force 'F' is applied on it to tighten a nut such that it passes through the pivot point, then torque is
A) Zero
B) Ff
C) Fl sin 0
D) Fl sin 0λ

Q. 11 Time of projectile's flight is

A) ...

B) $\frac{2v_i \sin\theta}{g}$

C) ...

D) $v_i^2 \sin^2\theta$

Q. 12 If the velocity of the body changes by equal amount in equal intervals of time the body is said to have:

A) variable acceleration

B) uniform acceleration

C) uniform velocity

D) negative acceleration

Q. 13 For finding the height of projectile, the equation used is:

A) ...

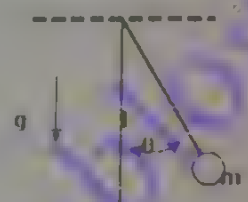
B) ...

C) $S = 2a(v_f^2 - v_i^2)$

D) $a = 2S(v_f^2 - v_i^2)$

2011

Q. 14 A simple pendulum length 'L' with bob of mass 'm' is slightly displaced from its mean position so that it string makes an angle 'θ' with vertical line as shown in the fig. Then bob of pendulum released. What will be the expression of torque with which bob starts to move towards the mean position?



A) mgl

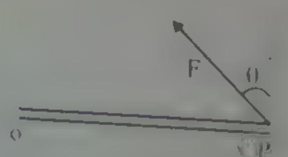
B) mgL sin θ

C) 0

D) mgL cos θ

2012

Q. 15 A force 'F' is acting at point 'P' of a uniform rod capable to rotate about 'O'. What is the torque about



A) ...

B) ...

C) (OP)(F sinθ)

D) (OP)(F cosθ)

2013

Q. 16 Ratio of moment of inertia of two object 'A' and 'B' is 2:3. Which of the following is ratio of torques of 'A' and 'B' respectively if both being rotated with constant angular acceleration?

A) ...

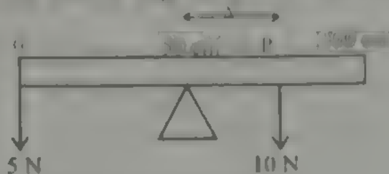
B) 2:3

C) 3:2

D) 4:9

2014

Q. 17 Two forces 5 N and 10 N are acting at O and P respectively on a uniform meter rod suspended at the position of centre of gravity 50 cm mark as shown in the figure.

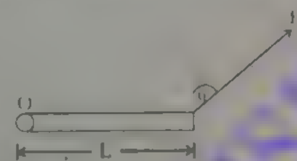


Then Find the position of point "P" on meter rod

A) [illegible] cm
B) 10 N
C) 25 cm
D) 65 cm

2015

Q. 18 A bar of length 'L' pivoted at 'O' is acted by a force 'F' at an angle 'θ' with vertical line as shown in figure



What is the moment of force?

A) L sinθ
B) F cosθ
C) LF cosθ
D) LF sinθ

2016

Q. 19 If we double the moment arm the value of torque becomes

A) Half
B) Three times
C) Two times
D) Four times

2017

Q. 20 The ratio of displacement along diameter and total distance along circle:

A) 1 : π
B) π : 1
C) 2 : π
D) π : 2

Q. 21 Arshad is driving down 7th street. He drives 150 meter is 18 seconds. Assume he does not speed up or slow down. What is his speed?

A) [illegible]
B) [illegible] m/s
C) 8.33m/s
D) 58.33m/s

Q. 22 The distance travelled by a moving car with velocity 15 m/s in 2 seconds, decelerates at $2 m/s^2$ is equal to

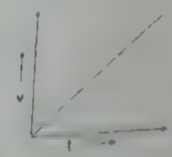
A) [illegible]
B) [illegible]
C) 16m
D) 26m

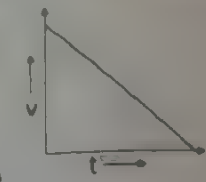
Retake test 2017

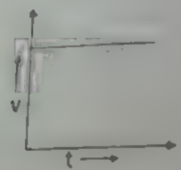
Q. 23 The value of ratio of displacement to distance is:

A) [illegible]
B) [illegible]
C) More than one
D) Equal or less than one

Q. 24 Which of the following v-t graph represents the constant acceleration:

A) 

C) 

B) 

D) All of these

Q. 25 A force F is applied to a beam at a distance d from a pivot. The force acts at an ang... to a line perpendicular to the beam:

Which combination will cause the largest turning effect about the pivot?

	F	D	θ
A)	Large	Large	Large
B)	Large	Large	Small
C)	Small	Small	Large
D)	Small	Large	Small

2018

Q. 26 If slope of velocity time graph is not constant at different points then body is m... with

A) Uniform velocity
B) increasing acceleration
C) average acceleration
D) constant acceleration

Q. 27 A cyclist is traveling at $15ms^{-1}$ she applies brakes so that she doesn't collide with the ... in front of her distance of 18m. Calculate the magnitude of deceleration.

A) $6.3ms^{-2}$
B) $5.3ms^{-2}$
C) $13ms^{-2}$
D) $12.5ms^{-2}$

Q. 28 Newton first law of motion is also known is

A) law of inertia
B) law of electromagnetism
C) law of universal gravity
D) law of conservation

2019

Q. 29 If two objects of equal masses 'm' are moving towards each other with the same 'v' then what will be the total final momentum after elastic head-on collision?

A) -mv kg/s
B) mv kg m/s
C) 2 mv kg/s
D) 0 kg m/s

Q.30 For projectile motion in the absence of air resistance:

A) vertical speed is constant

B) horizontal force is constant

C) horizontal acceleration is zero

D) vertical acceleration is zero

Q.31 The range of the projectile depends upon the velocity of the projection and the angle of the projection i.e 45°. For a fixed velocity, when the angle of projection is larger than 45°. Which of the following is correct?

A) both the height and the range attained by the projectile will be less

B) both the height and the range attained by the projectile will be more

C) The height attained by the projectile will be less but the range is more

D) The height attained by the projectile will be more but the range is less

ANSWER KEY

1	A	11	B	21	C	31	D
[illegible]	D	[illegible]	B	[illegible]	D		
[illegible]	A	[illegible]	B	[illegible]	D		
[illegible]	D	[illegible]	B	[illegible]	A		
[illegible]	C	[illegible]	D	[illegible]	B		
[illegible]	A	[illegible]	B	[illegible]	B		
[illegible]	A	[illegible]	A	[illegible]	A		
[illegible]	B	[illegible]	C	[illegible]	A		
[illegible]	D	[illegible]	C	[illegible]	D		
10	A	20	A	30	C		

EXPLANATORY NOTES

Q. 1 The vertical velocity of ball thrown upward Decreases linearly with time

Q. 2 An unpowered and unguided missile is called ballistic missile

Q. 3 Constant angular velocity $\omega = c \Rightarrow \alpha = 0$

$\tau = I\alpha$

$\tau = I(0) = 0$

Q. 4 $v_f = v_i + at$

$$a = \frac{v_f - v_i}{t} = \frac{1.5\times10^3 - 2\times10^3}{50} = \frac{-0.5\times10^3}{10\times50} = -10 m/s^2$$

Q. 5 When a massive body collide with a light body then

$v_1' \approx v_1 \quad v_2' \approx 2v_1$

Q. 6 $\tau = I\alpha \quad \therefore I = mr^2$

$\tau = mr^2\alpha$

Q. 7 $R = \frac{v_i^2 \sin 2\theta}{g}$

Q. 8 $F = \frac{\Delta P}{\Delta t} \Rightarrow \Delta t = \frac{P_f - P_i}{F}$

$$\Delta t = \frac{36-60}{12} = \frac{-24}{12} = 2 \sec$$

Time is always taken as positive.

Q. 9 For a body to be in complete equilibrium

(i) $a = 0$ (ii) $\alpha = 0$

Q. 10 When line of action of force passes through pivot point

$\ell = 0$

$\tau = F\ell = F(0) = 0$

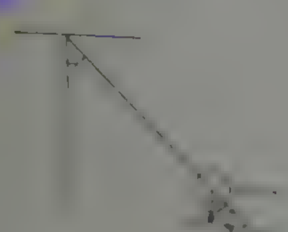
Q. 11 $T = \frac{2v_i \sin\theta}{g}$

Q. 12 Definition of uniform acceleration.

Q. 13 For finding the height of projectile, the equation used is

$2as = v_f^2 - v_i^2$

Q. 14



$\tau = 1$ [illegible]

[illegible]

Q. 15 $\tau = (OP)F\sin(90^\circ - \theta)$

$\tau = (OP)F\cos\theta$

Q. 16 $\frac{\tau_A}{\tau_B} = \frac{I_A\alpha}{I_B\alpha} = \frac{I_A}{I_B} = \frac{2}{3}$

Q. 17 $\tau_1 = \tau_2$

$r_1F_1 = xF_2$

$\frac{50}{100}\times 5 = x10$

$x = \frac{250}{1000} = \frac{1}{4} = 25\text{ cm}$

So position of point P on meter rod is $50\text{cm} + 25\text{cm} = 75\text{cm}$

Q. 18 $\tau = L(F\cos\theta)$

Q. 19 $\tau \propto F$; $\tau \propto \ell$

if $\ell' = 2\ell$ then

$\tau' = 2\tau$

Q. 20 $|\vec{d}| = 2r$ (along diameter)

$S = 2\pi r$ (distance along circle)

$\frac{|\vec{d}|}{S} = \frac{2r}{2\pi r} = 1:\pi$

Q. 21 $|\vec{V}_{av}| = \frac{|\vec{d}|}{t} = \frac{150}{18} = 8.33\,\text{ms}^{-1}$

Q. 22 $S = \frac{1}{2}at^2 + v_it = \frac{1}{2}(-2)(2)^2 + (15\times 2)$

$S = -4 + 30 = 26\,\text{m}$

Q. 23 Value of ratio of displacement to distance is equal to 1 for straight path and less than 1 for others path.

Q. 24 Slope $= a = \frac{\Delta v}{\Delta t} =$ constant

Q. 25 $\tau = FL\cos\theta$

For largest toruqe

F and L large and θ small

Q. 26 The acceleration either increase or decrease.

Q. 27 $2as = v_f^2 - v_i^2$ $\quad\because v_f = 0$

$a = \frac{v_i^2}{2s} = \frac{15^2}{2\times 18} = 6.25\,\text{ms}^{-2}$

Q. 28 Newton first law of motion is also known is law of inertia.

Q. 29 By using law of conservation of linear momentum.

Total final momentum = Total initial momentum

Total final momentum= mv – mv =0

Q. 30 $F_x = ma_x = 0$

$a_x = 0$

v_x = constant

Q. 31 $R = \dfrac{v_i^2 \sin 2\theta}{g}$

$h = \dfrac{v_i^2 \sin^2 \theta}{2g}$

If angle of projection is larger then 45°.

$\sin 2\theta \downarrow$ $R \downarrow$

$\sin \theta \uparrow$ $h \uparrow$

TOPIC-3 WORK, ENERGY AND POWER

PRACTICE EXERCISE

TOPIC-WISE MCQ's

WORK IN TERMS OF THE PRODUCT OF A FORCE AND DISPLACEMENT IN THE DIRECTION OF THE FORCE

Q.1 At what angle the work done will be half of its maximum value
A) 0°
B) 45°
C) 30°
D) 60°

Q.2 A man pushes a wall with 50 (N) and it displaces it zero (m), his work is
A) Negative
B) Positive
C) no work
D) may all possible

Q.3 If a mass of 5 Kg is lifted upto 5m height, what will be the work done against the gravitational field
A) 245 J
B) 49 J
C) 25 J
D) 98 J

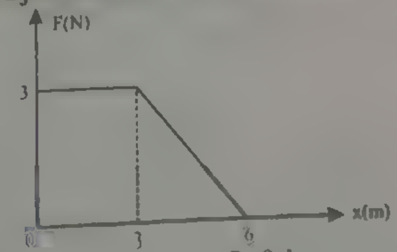
Q.4 A person walks 2 m with an acceleration of 5 m s^{-2}, holding an object of mass 2 kg. The net work done on the object is
A) 20 J
B) 5 J
C) 10 J
D) 0 J

Q.5 A force of $3\hat{i}+2\hat{j}+4\hat{k}$ N gives displacement of 10 $\hat{j}$ m. The work done is
A) 20 J
B) 32 J
C) 26 J
D) zero

Q.6 A body travels displacement of 10 m by force of 5 N If work done is 25 J then angle between $\vec{F}$ and $\vec{d}$ is
A) 0°
B) 30°
C) 45°
D) 60°

Q.7 A person holds a bucket of weight 60 N. He walks 7 m along the horizontal path and then climbs up a vertical distance of 5 m. The work done by the gravity is:
A) 300 N-m
B) 420 N-m
C) 720 N-m
D) none of these

Q.8 A force F acting on an object varies with distance x as shown in fig. The work done by the force in moving the object from x = 0 to x = 6 m is



A) 18 J
B) 13.5 J
C) 9 J
D) 4.5 J

Q.9 If force and displacement of particle in direction of force are doubled. Work would be
A) double
B) half
C) 1/4 times
D) 4 times

Q.10 A particle of mass 100g is thrown vertically upwards with a speed of 5m/s. The work done by the force of gravity during the time the particle goes up is

A) 1.25 J
B) 0.5 J
C) –0.5 J
D) –1.25 J

Q.11 A person is holding a bucket by applying a force of 10N. He moves a horizontal distance of 5m and then climbs up a vertical distance of 10m. Find the total work done by him?

A) 50J
B) 150J
C) 100J
D) 200J

Q.12 A gardener pushes a lawn roller through a distance of 20m. If he applies a force of 20 kg weight in a direction inclined at 60° to the ground, find the work done by him ($g=9.8m/s^2$)

A) 400J
B) 1960J
C) 250J
D) 2514J

KINETIC ENERGY K.E = 1/2 MV^2

Q.13 What will be the ratio of kinetic energies of alpha particle and proton if their linear momentum will be same

A) 18 : 1
B) 1 : 4
C) 4 : 1
D) 10^4 : 1

Q.14 One erg is equal to

A) 10^{-5} dynes
B) 10^{-7} watt
C) 10^{-7} joules
D) 10^{5} newton

Q.15 The Bodies of one kg and four kg have same kinetic energy. The ratio in their momenta will be

A) 1 : 2
B) 1 : 16
C) 1 : 4
D) 1 : 1

Q.16 The velocity and momentum of a moving body are 10,000 cm s^{-1} and 10,000 g cm s^{-1} respectively. The K.E will be

A) 5×10^7 J
B) 5×10^{-2} J
C) 5×10^8 J
D) 5×10^0 J

Q.17 If momentum of a moving object is doubled then its kinetic energy will be

A) doubled
B) halved
C) four times
D) same

Q.18 The momentum and kinetic energy of a ball is numerically equal. The numerical value of velocity is

A) 1 m s^{-1}
B) 2 m s^{-1}
C) 3 m s^{-1}
D) 4 m s^{-1}

Q.19 Kinetic energy of a body moving with speed of 10 m s^{-1} is 30 J. If its speed becomes 30 m/s its K.E will be

A) 10 J
B) 180 J
C) 90 J
D) 270 J

Q.20 Car X is traveling at half the speed of car Y. Car X has twice mass of car Y. Which statement is correct?

A) Car X has half the kinetic energy of car Y
B) Car X has one quarter of the kinetic energy of car Y
C) Car X has twice the kinetic energy of car Y
D) The two cars have the same kinetic energy

Q.21 The amount of work required to stop a moving object is equal to:
A) The velocity of the object
B) The mass of the object times its velocity
C) The kinetic energy of the object
D) The mass of the object times its acceleration

Q.22 A ball of mass 2 kg and another of mass 4 kg are dropped together from a 60 feet tall building. After a fall of 30 feet each towards earth, their respective kinetic energies will be in the ratio of:
A) $\sqrt{2}:1$
B) 1 : 4
C) 1 : 2
D) $1:\sqrt{2}$

Q.23 A bomb of mass 30 kg at rest explodes into two pieces of masses 18 kg and 12 kg. The velocity of 18 kg mass is 6 m s^{-1}. The K.E of other mass is
A) 324 J
B) 486 J
C) 256 J
D) 524 J

Q.24 Kinetic energy of a body moving with speed of 10 ms^{-1} is 30 J. If its speed becomes 30 ms^{-1} then its K.E becomes
A) 10 J
B) 90 J
C) 270 J
D) 180 J

Q.25 The kinetic energy acquired by a body of mass m is travelling some distance s, starting from rest under the actions of a constant force, is directly proportional to
A) m^0
B) m^2
C) m
D) $m^{1/2}$

Q.26 All the food we eat in one day has about the same energy as:
A) One liter of petrol
B) $\frac{1}{2}$ liter of petrol
C) $\frac{1}{3}$ liter of petrol
D) $\frac{1}{4}$ liter of petrol

Q.27 When force and displacement are in the same direction, the kinetic energy of the body
A) Increases
B) Decreases
C) Remains constant
D) Becomes zero

Q.28 A truck and a car are moving with equal velocity. On applying brakes, both will stop after a certain distance, then?
A) Truck will cover less distance before stopping
B) Car will cover less distance before stopping
C) Both will cover equal distance
D) None of the mentioned

POTENTIAL ENERGY P.E = mgh

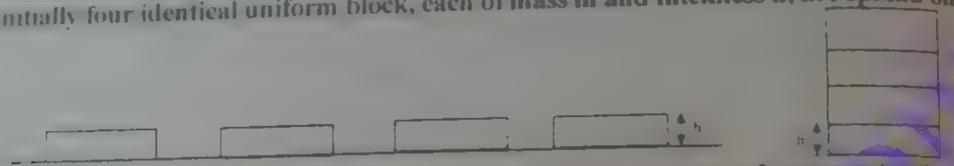
Q.29 Potential energy per unit volume is given by
A) mgh
B) $\frac{mgh}{\rho}$
C) gh
D) ρgh

Q.30 A body is dropped from 1000m height, if its potential energy is 8×10^8 J. What will be its velocity on reaching the ground?
A) 1410 m s^{-1}
B) 141 m s^{-1}
C) 1.41 m s^{-1}
D) 9800 m s^{-1}

Q.31 A body is falling from a height h. After it has fallen a height h/2, it will possess
A) Only potential energy
B) Only kinetic energy
C) Half potential and half kinetic energy
D) More kinetic and less potential energy

Q.32 Energy stored in the spring of watch is
A) Electrical energy
B) Kinetic energy
C) potential energy
D) Elastic potential energy

Q.33 Initially four identical uniform block, each of mass m and thickness h, are spread on a table



How much work is done on the hook in stacking them on top of one another?
A) 2 mgh
B) 4 mgh
C) 3 mgh
D) 6 mgh

Q.34 A ball is thrown vertically upwards. Neglecting air resistance, which statement is correct?
A) The kinetic energy of the ball is greatest at the greatest height attained
B) The potential energy of the ball increase uniformly with time during the ascent.
C) By the principle of conservation of momentum, the momentum of the ball is constant throughout its motion
D) By the principle of conservation of energy, the total energy of the ball is constant throughout its motion

Q.35 A stone is thrown up from the surface of earth when it reaches at maximum height its total energy is equal to
A) mgh
B) zero
C) $\frac{1}{2}mv^2$
D) 2 mgh

Q.36 You lift a suit case from the floor and keep it on a table. The work done by you on the suitcase does not depend on.
A) the path taken by the suitcase
B) initial and final position
C) weight of the suitcase
D) None

INTER-CONVERSION OF KINETIC ENERGY AND POTENTIAL ENERGY IN GRAVITATIONAL FIELD

Q.37 If 10 kg mass is dropped from a certain height, hits the ground with speed 10 ms⁻¹ height will be
A) 100 m
B) 10 m
C) 50 m
D) 5 m

Q.38 In freely falling system, if potential energy is equal to kinetic energy. Then force of friction of air will
A) be negligible
B) be maximum
C) be zero
D) not be predicted

Q.39 In the presence of air friction, the relation for free falling body is
A) $mgh = \frac{1}{2}mv^2 - fh$
B) $mgh = fh - \frac{1}{2}mv^2$
C) $mgh = \frac{1}{2}mv^2 + fh$
D) $mgh = fg + \frac{1}{2}mv^2$

POWER IN TERMS OF WORK DONE PER UNIT TIME AND USE POWER AS PRODUCT OF FORCE AND VELOCITY

P = W/t and P = Fv

Q.40 **A 500N force is applied on an object and it moves with velocity 10ms^{-1}. If value of power is 2500 watt. Then what will be the angle between force and displacement**

A) 0°
B) 60°
C) 90°
D) 23°

Q.41 **The time taken by an engine of power 10 kW to lift a mass of 200 kg to the height of 40 m is**

A) 2 s
B) 4 s
C) 8 s
D) 16 s

Q.42 **To travel at a constant speed, a car engine provides 24 kW of useful power. The driving force on the car is 600 N. At what speed does it travel?**

A) 25 ms^{-1}
B) 4.0 ms^{-1}
C) 2.5 ms^{-1}
D) 40 ms^{-1}

Q.43 **A force of 1000 N is needed to lift the hook of a crane at a steady velocity. The crane is then used to lift a load of mass 1000 kg at a velocity of 0.50 $m\,s^{-1}$. How much of the power developed by the motor of the crane is used in lifting the hook and the load? (Take g as 10 $m\,s^{-2}$).**

A) 5.0 kW
B) 20 kW
C) 5.5 kW
D) 22 kW

Q.44 **The power output of a lamp is 6W. How much energy does the lamp give out in 2 minutes?**

A) 3 J
B) 120 J
C) 720 J
D) 430 J

Q.45 **A man M_1 of mass 80 kg runs up a staircase in 15 s. Another man M_2 also of mass 80 kg runs up the same staircase in 20 s. The ratio of the power developed by them will be:**

A) 1
B) 4:3
C) 16/9
D) none of these

Q.46 **An engine pumps up 100 kg of water through a height of 10 m in 5s. Given that the efficiency of the engine is 60%, what is the power of the engine? (Take g = 10 m s^{-2})**

A) 33 kW
B) 3.3 kW
C) 0.33 kW
D) 0.033 kW

Q.47 **An engine pumps out 40 kg of water in one second. The water comes out vertically upwards with a velocity of 3 m s^{-1}. What is the power of engine in kilowatt?**

A) 1.2 kW
B) 12 kW
C) 120 kW
D) 1200 Kw

Q.48 **An elevator's motor produces 3000 W power. The speed with which it can lift a 1000 kg load is:**

A) 30.6 m s^{-1}
B) [illegible]
C) 0.306 m s^{-1}
D) 300.6 m s^{-1}

Q.49 The power needed to lift a mass of 5000g to height of 1 m in 2 second is

A) 2.45 watt
B) 245 watt
C) 24.5 watt
D) 2.45 k watt

Q.50 An engine pulls a car of mass 1500 kg on a level road at a constant speed of 5 ms^{-1}. If frictional force is 500 N, what power does the engine generate?

A) [illegible]
B) 2.5 kW
C) 10 kW
D) 12.5 kW

ANSWER KEY

1	D	11	C	21	C	31	C	41	C
2	C	12	B	22	C	32	D	42	D
3	A	13	B	23	B	33	D	43	C
4	A	14	C	24	C	34	D	44	C
5	A	15	A	25	A	35	A	45	B
6	D	16	D	26	C	36	A	46	B
7	A	17	C	27	A	37	D	47	A
8	B	18	B	28	B	38	C	48	C
9	D	19	D	29	D	39	C	49	C
10	D	20	A	30	B	40	B	50	B

EXPLANATORY NOTES

$W = (ma)d$

Q.8 W = Area under F – x graph

W = $\frac{1}{2}$ (Sum of parallel sides) (Perpendicular distance between parallel sides)

= $\frac{1}{2}$ (6 + 3)(2) = 15 J

Q.9 Work = Force × Displacement. If force and displacement both are doubled then work becomes four times.

Q.10 Work done by the force of gravity = Loss in kinetic energy of the ball

Work done by the force of gravity = $\frac{1}{2}m(v_f^2 - v_i^2) = \frac{1}{2} \times \frac{100}{1000} \times (0^2 - 5^2)$

Work done by the force of gravity = 1.25 J.

Q.11 F = 10N, s = 5m, θ = 90°

Work done, $W_1 = Fs\cos\theta = 10 \times 5 \times \cos 90° = 0$

For vertical motion, the angle between force and displacement is 0°.

Here, F = 10N, s = 10m, θ=0°

Work done, $W_2 = 10 \times 10 \times \cos 0 = 100J$

Total work done = $W_1 + W_2$ = 100J.

Q.12 F = w = mg = 20 × 9.8N

s = 20m

θ = 60°

W = Fscos0 = 20 × 9.8 × 20×cosθ 60

W = 1960J

Q.13 Mass of α - paricle = 6.644×10^{-27} kg

mass of proton = 1.672×10^{-27} kg

$p_\alpha = p_p$

$K.E = \frac{p^2}{2m}$ K.E ∝ $\frac{1}{m}$

$\frac{K.E_\alpha}{K.E_p} = \frac{m_p}{m_\alpha} = \frac{1.672 \times 10^{-27}}{4(1.672 \times 10^{-27})} = \frac{1}{4}$

Q.14 1 J = 10^7 erg

Q.15 K.E = K.E

$E \propto m$

$\frac{E_1}{E_2} = \frac{m_1}{m_2} = \frac{p_1}{p_2} \sqrt{\frac{m_2}{m_1}} = \frac{p_1}{p_2} \sqrt{\frac{1}{4}} = \frac{1}{2}$

Q.16 [illegible]

Q.17 $K.E = \frac{p^2}{2m}$

$p' = 2p$

$K.E' = \frac{(2p)^2}{2m} = \frac{4p^2}{2m} = 4K.E$

$K.E' = 4K.E$

Q.18 $P = K.E$

$mv = \frac{1}{2}mv^2$

$2v = v^2$

$v = 2\,m/s$

Q.19 $K.E \propto v^2$

$K.E' \propto v'^2$

$K.E' = K.E\left(\frac{v'}{v}\right)^2$

$K.E' = 30 \times \frac{900}{100} = 270\,J$

Q.20 $v' = \frac{v}{2}$, $m' = 2m$

$K.E' = \frac{1}{2}m'v'^2 = \frac{1}{2}(2m)\left(\frac{v}{2}\right)^2 = \frac{1}{2}(2m)\left(\frac{v^2}{4}\right) = \frac{1}{2}\left(\frac{1}{2}mv^2\right) = \frac{1}{2}K.E = \frac{K.E}{2}$

Q.21 [illegible]

Q.22 [illegible] falling from same height so speed is same $v = \sqrt{2g(h_1 - h_2)}$

[illegible]

Q.23 [illegible]

Q.24 $K.E = \frac{1}{2}mv^2$

$K.E \propto v^2$ (m=constant)

if $v' = 3v$, then $K.E' = 9K.E$

$K.E' = 9K.E$

$= 9(30)$

$K.E = 270J$

Q.25 $K.E = \frac{1}{2}mv^2 \Rightarrow K.E \propto v^2$ $\therefore$ does not depend upon mass for a single body

(As mass is constant)

Q.26 Book information

Q.27 When force and displacement are in the same direction, the kinetic energy of the body increases. The increase in kinetic energy is equal to the work done on the body.

Q.28 Being lighter than a truck, the car has less kinetic energy. On applying brakes with the same force, the car will cover less distance before coming to rest.

Q.29 $\frac{P.E}{V} = \frac{mgh}{V} = \rho gh$

Q.30 $v = \sqrt{2gh}$

$v = \sqrt{2\times10\times1000} = \sqrt{20000} = 141\ m/s$

Q.31 P.E = mgh

$P.E' = \frac{mgh}{2}$ $\left(\because h' = \frac{h}{2}\right)$

$P.E' = \frac{P.E}{2}$

So at h/2, body has half P.E and half K.E.

Q.32 Spring has elastic potential energy.

Q.33 $W = mg(0h) + mg(1h) + mg(2h) + mg(3h)$

$W = 0 + mgh + 2mgh + 3mgh$

$W = 6mgh$

Q.34 T.E remains same through the motion

Q.35 At maximum height:

T.E = K.E + P.E

Q.36 (a) and (b) gravitational force is conservative: work done is independent of path and time

Q.37 Loss in P.E = Gain in K.E

$$mgh = \frac{1}{2}mv^2 \Rightarrow h = \frac{v^2}{2g} = \frac{(10)^2}{2\times10} = \frac{100}{20} = 5m$$

Q.38 $mgh = \frac{1}{2}mv^2 + fh$

if, $mgh = \frac{1}{2}mv^2$

then, $fh = 0$

$f = 0$

Q.39 $mgh = \frac{1}{2}mv^2 + fh$ (In the presence of friction)

Q.40 $P = \vec{F}.\vec{v}$

$P = Fv\cos\theta$

$\theta = \cos^{-1}\left(\frac{P}{Fv}\right)$

$= \cos^{-1}\left(\frac{2500}{500\times10}\right)$

$= \cos^{-1}\left(\frac{1}{2}\right) = 60^\circ$

Q.41 $P = \frac{W}{t} = \frac{mgh}{t}$

$t = \frac{200\times9.8\times40}{10\times10^3} = 7.84s$

$t \approx 8s$

Q.42 $P = \vec{F}.\vec{v}$

$P = Fv\cos\theta$

$\theta = 0$

$P = Fv$

$v = \frac{P}{F} = \frac{24000}{600} = 40\ ms^{-1}$

Q.43 $F = F_g + F_a$

$F = 1000 + 1000\times10 = 11000N$

$P = Fv$

$P = 11000\times0.50 = 5500W = 5.5kW$

Q.44 $t = 2 \times 60 = 120\,s$

$P = \frac{E}{t}$

$E = Pt = 6 \times 120$

$E = 720\,J$

Q.45 $P = \frac{mgh}{t}$

As, $M_1 = M_2 = m$

h = same

$\frac{P_1}{P_2} = \frac{t_2}{t_1}$

$= \frac{20}{15}$

$= \frac{4}{3}$

Q.46 $(P) = \frac{mgh}{t}$

$P = \frac{100 \times 10 \times 10}{5 \times 0.6}$

$P = 3333.3\,W$

$P = 3.3\,kW$

Q.47 $P = \frac{mgh}{t}$

$P = mgv$

$= 40 \times 10 \times 3$

$= 1200\,W$

$= 1.2 \times 10^3\,W = 1.2\,KW$

Q.48 $P = Fv$

$P = mgv \Rightarrow v = \frac{P}{mg} = \frac{3000}{1000 \times 10} = 0.306\,ms^{-1}$

Q.49 $P = \frac{mgh}{t} = \frac{\frac{5000}{1000} \times 10 \times 1}{2} = \frac{50}{2} = 24.5\,W$

Q.50 $P = Fv = 500 \times 5 = 2500 = 2.5\,kW$

PAST PAPER MCQ's (2008-2019)

[illegible]

Q.1 A force 2i + j has moved its point of application from (2,3) to (6,5). What is work done?
A) -10
B) +10
C) -18
D) +18

Q.2 100 joules work has been done by an agency in 10 seconds. What is power of agency?
A) 1000 watt
B) 100
C) 10 watt
D) 0.10 watt

Q.3 Work done on a body equals change in its __________ energy.
A) Total
B) Potential
C) Kinetic.
D) All of these

2009

Q.4 If a certain force acts on an object and changes its kinetic energy from 65 J to 130 J, then work done by the force will be:
A) 92.5 J
B) 97.5 J
C) 65J
D) 130 J

2010

Q.5 The consumption of energy by 60-watt bulb in 2 seconds is:
A) 20J
B) 120 J
C) 30J
D) 0.02 J

Q.6 Which one of the following is a non-conservative force?
A) Electric force
B) Elastic spring force
C) Gravitational force
D) Frictional force

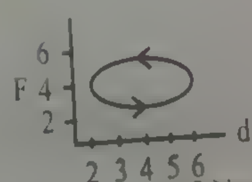
Q.7 **If velocity is double, then.**
A) Momentum increase 4 times and K.E increases 2 times
B) Momentum and K.E remain same
C) Momentum increases 2 times and K.E increase constant
D) Momentum increases 2 times and K.E increases 4 times

2016

Q.8 Potential energy per unit volume is given by
A) mgh
B) $\frac{mgh}{\rho}$
C) gh
D) ρgh

2017

Q.9 Total work done in figure



A) 24 Nm
B) 16 Nm
C) 8 Nm
D) Zero Nm

Q.10 Work done will be zero if angle between Force and displacement is:
A) 0
B) 60°
C) 270°
D) 360°

Q.11 If mass 'm' is dropped from height 'h' vertically, f is the force of friction during downward motion and 'v' is the velocity at bottom, following equation will be hold:
A) $\frac{1}{2}mv^2 = mgh + fh$
B) $mgh = \frac{1}{2}mv^2 - fh$
C) $fh = mgh + \frac{1}{2}mv^2$
D) $mgh = \frac{1}{2}mv^2 + fh$

[illegible] 2017

Q.12 At what angle work done will be maximum?
A) 0°
B) 90°
C) 45°
D) 30°

Q.13 Which one of the following is a greater work?
A) +100 J
B) -100 J
C) −1000 J
D) +200 J

Q.14 The figure shows the force distance curve of a body moving along a straight line work done by the force:

A) 10 J
B) 20 J
C) 30 J
D) 40 J

2018

Q.15 Energy consumed by 60 watt bulb in 2 minutes is equal to
A) 7.2 kilo joules
B) 720 joules
C) 120 joules
D) 72000 joules

Q.16 A stone of mass 2.0 kg is dropped from a rest position 5.0m above the ground. What is its velocity at a height of 3.0m above the ground?
A) 12.5m/s
B) 6.3m/s
C) 9.3m/s
D) 16.0m/s

Q.17 The rate at which work is being done is called:
A) Power
B) Energy
C) Density
D) Force

2019

Q.18 An automobile is moving forwards with uniform velocity due to the force exerted by engine. If that force is double with the velocity remaining constant what happens to total power?
A) It does not change
B) It is squared
C) It is halved
D) It is doubled

Q.19 Which of the following is statement shows that no work is done?
A) pushing a car to start it moving
B) writing an essay on a page
C) lifting the weights
D) the moon orbiting the earth

ANSWER KEY

1	B	11	D
2	C	[illegible]	A
3	D	[illegible]	C
4	C	[illegible]	A
5	B	[illegible]	A
6	D	[illegible]	B
7	D	[illegible]	A
[illegible]	D	18	D
[illegible]	D	19	D
10	C		

EXPLANATORY NOTES

Q.1 $\vec{d} = (6-2)\hat{i} + (5-3)\hat{j}$

$\vec{d} = 4\hat{i} + 2\hat{j}$

$W = \vec{F}.\vec{d}$

$= (2\hat{i} + \hat{j}).(4\hat{i} + 2\hat{j})$

$= 8(\hat{i}.\hat{i}) + 2(\hat{j}.\hat{j})$ $\qquad \hat{i}.\hat{i} = \hat{j}.\hat{j} = 1$

$= 8 + 2 = 10$

Q.2 $P = \dfrac{W}{t} = \dfrac{100}{10} = 10W$

Q.3 According to Work-energy principle
W.D on a body=change in K.E
W.D on a body=change in P.E (W.D on spring)
W.D on a body=change in T.E (W.D on mass-spring system)

Q.4 According to work-energy principle
$W.D = \Delta K.E$

$= 130 - 65 = 65J.$

Q.5 $P = \dfrac{W}{t}$

$W = P \times t = 60 \times 2 = 120J.$

Q.6 Frictional force is a non-conservative force

Q.7 If velocity is doubled then $v' = 2v$

$K.E = \dfrac{1}{2}mv^2$

$P = mv$ $\qquad K.E' = \dfrac{1}{2}m(2v)^2$

$P' = m(2v) = 2mv$

$P' = 2p$ $\qquad = 4\left[\dfrac{1}{2}mv^2\right]$

$K.E' = 4K.E$

Q.8 $\dfrac{P.E}{V} = \dfrac{mgh}{V} = \rho gh$

Q.9 Work done in closed path is zero.

Q.10 $W = Fd\cos\theta = Fd\cos 270^\circ = 0$

Q.11 $mgh = \dfrac{1}{2}mv^2 + fh$

Q.12 $W = Fd\cos\theta$

$\theta = 0^\circ$

$w = Fd\cos(0)$

$w = Fd$

Q.1[illegible] [illegible] is a greater work in given options

[illegible]

Q.17 [illegible]

Q.18 [illegible]

Q.19 Work done in a closed path is zero.

TOPIC-4 CIRCULAR MOTION

PRACTICE EXERCISE

TOPIC-WISE MCQ's

ANGULAR MOTION, ANGULAR DISPLACEMENT & ANGULAR VELOCITY

Q.1 **The linear and angular velocities of a particle moving about the centre of a circle of radius r, are related by**

A) $\vec{v} = \vec{\omega} \times \vec{r}$
B) $\vec{v} \times \vec{\omega} = \vec{r}$
C) $\vec{v} = \vec{r} \times \vec{\omega}$
D) $\vec{\omega} \times \vec{v} = \vec{r}$

Q.2 If a car moves with a uniform speed of 2 m s^{-1} in a circle of radius 0.4 m. Its angular speed is

A) 4 rad s^{-1}
B) 5 rad s^{-1}
C) 1.6 rad s^{-1}
D) 2.8 m s^{-1}

Q.3 A disc of radius R=20 cm is rotating about its axis with an angular velocity $\omega = 20\,rad/s$ on a horizontal smooth surface. The linear speed of point C on the disc is

A) $1\,ms^{-1}$
B) $2\,ms^{-1}$
C) $4\,ms^{-1}$
D) $4\pi\,ms^{-1}$

Q.4 If a rotating body is moving counter clockwise, direction of angular velocity will be

A) along linear velocity
B) along the axis of rotation
C) towards the center
D) away from center

Q.5 **For a body moving with constant speed in a horizontal circle, which of the following remains constant?**

A) Velocity
B) Acceleration
C) Centripetal force
D) Kinetic energy

Q.6 The length of the second hand of a watch is 1 cm. The velocity vector of the tip of the second hand in cm per second is

A) 2π
B) $\frac{2\pi}{12 \times 60}$
C) $\frac{2\pi}{60}$
D) $\frac{2\pi}{24 \times 60}$

Q.7 The ratio of angular frequency and linear frequency is

A) 2π
B) $\frac{1}{2\pi}$
C) π
D) $\frac{\pi}{2}$

Q.8 **If the position vector of a particle is** $\vec{r} = (3\hat{i} + 4\hat{j})$ meter and its angular velocity is $\vec{\omega} = (\hat{j} + 2\hat{k})$ **rad/sec then its linear velocity is (in m/s).**

A) [illegible]
B) [illegible]
C) $(3\hat{i} - 6\hat{j} + 8\hat{k})$
D) $(6\vec{i} - 8\vec{j} + 3\vec{k})$

Q.9 The angular momentum changes form 2 units to 6 units in 4 s the torque is

A) 1 unit
C) 3/[illegible] unit
B) $\frac{1}{2}$ unit
D) 4 unit

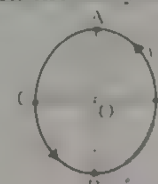
Q.10 In uniform circular motion, the factor that remains constant is

A) Linear velocity
C) Centripetal force
B) Acceleration
D) Speed

Q.11 A flywheel gains a speed of 540 rpm in 6 second. Its angular acceleration is

A) 3π rad s^{-2}
C) 6π rad s^{-2}
B) 9π rad s^{-2}
D) 12π rad s^{-2}

Q.12 One end of the string of length 1.0 m is tied to a body of mass 0.5 kg. It is whirled vertical circle as shown in figure below. If the angular frequency of the body is 4 rad what is the tension in the string when the body is at the topmost point A? Take g = 10 m



A) 3 N
C) 15 N
B) 13 N
D) 18 N

Q.13 A particle is moving with constant speed by keeping itself at constant distance fr fixed point in a given plane. Its motion is

A) Circular motion
B) Uniform circular motion
C) Uniform circular motion with fixed axis of rotation
D) Uniform circular motion with axis of rotation not defined

Q.14 For a particle in uniform circular motion the relation $a = r\alpha$ of accelerations hold acceleration 'a'

A) Is centripetal acceleration
C) Is tangential acceleration
B) Is radial acceleration
D) both A and B

Q.15 A point on the rim of a wheel 4 m in diameter has a velocity of 1600 cm s^{-1}. The an velocity of the wheel is

A) 2 rad s^{-1}
C) 4 rad s^{-1}
B) 6 rad s^{-1}
D) 8 rad s^{-1}

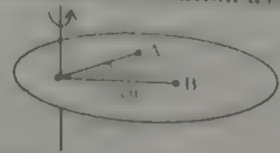
Q.16 The angular speed of a fly wheel making 120 revolutions/minute is

A) 2π rad/s
C) 4π rad/s
B) 3π rad/s
D) π rad/s

Q.17 If a body is moving in a circular path with constant speed, then the

A) Velocity and acceleration are perpendicular to each other
B) Velocity and acceleration are parallel to each other
C) Velocity and acceleration are anti-parallel
D) Both have zero magnitude

Q.18 A rigid body is rotating about an axis of rotation as shown.



The ratio of angular accelerations of point A to that of B.

A) 1 : 1
B) 2 : 3
C) 3 : 2
D) 1 : 6

Q.19 A wheel rotates about an axis passing through the centre and perpendicular to the plane with slowly increasing angular speed. Thus it has:

A) radial velocity and radial acceleration
B) tangential velocity and radial acceleration
C) tangential velocity and tangential acceleration
D) tangential velocity but acceleration having both components

Q.20 For positive angular displacement the rotation would be

A) clockwise
B) parallel
C) anti-clockwise
D) perpendicular

Q.21 The acceleration of a motor car is 8 m/s^2. If the diameter of its wheel be 2m. It's angular acceleration will be

A) 8 rad/s^2
B) 16 rad/s^2
C) 10 m/s^2
D) 10 rad/s^2

Q.22 When a wheel 1m in diameter makes 30 rev/min, the linear speed of point on it's rim in m s^{-1} is

A) 2π
B) 3π
C) $\frac{\pi}{2}$
D) 4π

Q.23 Ten seconds after an electric fan is turned on, the fan rotates at 300rev/min. Its average angular acceleration is

A) 30 rad/s^2
B) 3.14 rad/s^2
C) 30 rev/s^2
D) 500 rev/s^2

Q.24 The angular speed in radian/hour for daily rotation of the earth is

A) 2π
B) $\frac{\pi}{6}$
C) 4π
D) $\frac{\pi}{12}$

Q.25 The shaft of a motor rotates at a constant angular speed of 360rev/min. Angle turned through in 1 sec in radian is

A) π
B) 3π
C) 6π
D) 12π

Q.26 The angular velocity of the minute hand of a clock is

A) $\frac{2\pi}{60}$ rad s^{-1}
B) $\frac{2\pi}{[illegible]}$ rad s^{-1}
C) $\frac{\pi}{24}$ rad s^{-1}
D) $\frac{\pi}{3600}$ rad s^{-1}

CENTRIPETAL FORCE AND CENTRIPETAL ACCELERATION

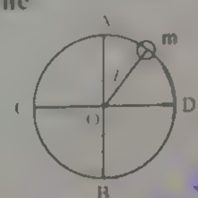
$F = mr\omega^2$, $F = mv^2/r$ and $a_c = r\omega^2$ and $a_c = v^2/r$

Q.27 Work done due to centripetal force for circular motion will be:
A) reduced C) half
B) maximum D) zero

Q.28 In case of planets the necessary acceleration is provided by
A) Gravitational force C) coulomb force
B) frictional force D) centripetal force

Q.29 The force which provides the necessary centripetal force to keep the mud in ... path is called
A) cohesive force C) adhesive force
B) frictional force D) gravitational force

Q.30 A small sphere is attached to a cord and rotates in a vertical circle about a point ... the average speed of the sphere is increased, the cord is most likely to break ... orientation when the mass is at the



A) bottom point B C) point D
B) point C D) top point A

Q.31 A stone of mass m tied to a string of length l is rotated in a circle with the other end of the string as the centre. The speed of the stone is v. If the string breaks, the stone ... move
A) Toward the centre of circle C) Away from centre of circle
B) Along the tangent D) All of these

Q.32 The mud flies off the tyre of a fast moving car in the direction
A) parallel to the moving tyre C) anti parallel to the moving tyre
B) tangent to the moving tyre D) none of these

Q.33 Two bodies of mass 10 kg and 5 kg moving in concentric orbits of radii R and r ... that their periods are the same. Then the ratio between their centripetal acceleration ...
A) R/r C) R^2/r^2
B) r/R D) r^2/R^2

GEOSTATIONARY ORBITS

Q.34 A car of 1000 kg traveling at 20m/sec rounds a curve of radius 100 m. Find the necessary centripetal force
A) 4×10^3 kgm/s^2 C) 5×10^3 kgm/s^2
B) [illegible] $\times 10^3$ kgm/s^2 D) 4.5×10^3 kgm/s^2

Q.35 Particle is moving in a circle of radius r with constant angular speed ω. Its acceleration directed towards the centre of the circle is
A) $\frac{\omega}{r}$ C) $\omega^2 r$
B) [illegible] D) ωr^2

Q.36 Two particle of equal masses are revolving in circular paths of radius r_1 and r_2, respectively with the same speed. The ratio of their centripetal force is

A) $\left(\frac{r_2}{r_1}\right)$

B) [illegible]

C) $\sqrt{\left(\frac{r_2}{r_1}\right)}$

D) $\left(\frac{r_1}{r_2}\right)^2$

Q.37 A body of mass m is moving in a circle of radius r with a constant speed v. The work done by the centripetal force in moving the body over half the circumference of the circle is

A) $m\frac{v^2}{r} \times 2r$

B) $\frac{mv^2}{r} \times \pi r$

C) $\frac{mv^2}{r} \times r$

D) Zero

Q.38 A particle moves in a circle of radius 25 cm at two revolutions per second. The acceleration of the particle in m/s^2 is

A) π^2

B) $8\pi^2$

C) $4\pi^2$

D) $2\pi^2$

Q.39 A stone of mass 250 g is tied to the end of a string of length 1.0 m. It is whirled in a horizontal circle with a frequency of 30 rev/min. What is the tension in a string?

A) $\frac{\pi^2}{4}$ N

B) $\frac{\pi^2}{2}$ N

C) π^2 N

D) $2\pi^2$ N

Q.40 The centripetal force acting on a body of mass m in a circle of radius r is

A) $\frac{mv^2}{r}$

B) $mr\omega^2$

C) $mr^2\omega$

D) both A and B

Q.41 The time period of revolution of geostationary satellite is

A) 1440 minutes

B) 84 minutes

C) 24 minutes

D) none of these

Q.42 A satellite moving round the earth constitutes

A) An inertial frame of reference

B) Neither inertial nor non inertial

C) Non inertial frame

D) Both inertial and non-inertial

Q.43 Two artificial satellites of unequal masses are revolving in a circular orbit around the earth with a constant speed. Their time periods:

A) will be different

B) will depend on their masses

C) will be same

D) will depend upon the place of their projection

Q.44 If the distance between the earth and the sun is reducing to one fourth, then the number of days in one year approximately

A) 183

B) 129

C) 46

D) 365

Q.45 The earth [illegible] revolves around the sun with an angular velocity [illegible] rad/s in a circular path of radius [illegible] $\times 10^{8}$ km. The force exerted by sun on earth is:

A) $6\times10^{[illegible]}$ N
C) $36\times10^{[illegible]}$ N
B) $18\times10^{[illegible]}$ N
D) $27\times10^{[illegible]}$ N

Q.46 One geostationary satellite covers
A) 60° longitude
C) 120° longitude
B) [illegible] latitude
D) 90° longitude

Q.47 If the earth is at one-fourth of its present distance from the sun, the duration of the year will be
A) one-eighth the present year
C) one-sixth the present year
B) one-fourth the present year
D) half the present year

Q.48 If the distance between the earth and the sun were half its present value, the number of days in year would have been
A) 64.5
C) 182.5
B) 129
D) 730

RADIAN

Q.49 $2\pi r$ subtends an angle of
A) 1 radian
C) 4 radian
B) 2 radian
D) 2π rad

Q.50 Radian is defined as the angle subtended at the center of a circle by an
A) arc whose length is parallel to the radius of circle
B) arc whose length is less than the radius of circle
C) arc whose length is greater than the radius of circle
D) arc whose length is equal to the radius of circle

ANSWER KEY

1	A	11	A	21	A	31	B	41	A
[illegible]	B	[illegible]	A	22	C	32	B	42	A
[illegible]	B	[illegible]	C	23	B	33	A	43	C
[illegible]	B	[illegible]	C	24	D	34	A	44	C
[illegible]	D	[illegible]	D	25	D	[illegible]	C	[illegible]	C
[illegible]	C	[illegible]	C	[illegible]	B	[illegible]	A	[illegible]	C
[illegible]	A	[illegible]	A	[illegible]	D	[illegible]	D	[illegible]	A
[illegible]	A	[illegible]	A	[illegible]	D	[illegible]	C	[illegible]	B
[illegible]	A	[illegible]	D	[illegible]	C	[illegible]	A	[illegible]	D
[illegible]	D	[illegible]	C	[illegible]	A	[illegible]	D	[illegible]	D

EXPLANATORY NOTES

Q.1 Relation between linear and angular velocity in vector form is $\vec{v} = \vec{\omega} \times \vec{r}$

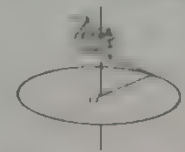
Q.2 $\omega = \frac{v}{r} = \frac{2}{0.4} = 5\,\text{rad}\,s^{-1}$

Q.3 $v = r\omega \quad \because r = \frac{R}{2}$

$= 10\times10^{-2}\times 20$

$v = 2\,ms^{-1}$

Q.4 Angular velocity is a axial vector so it is always along the axis of rotation



Q.5 As K.E depends upon magnitude of velocity i.e speed. In a horizontal circle as speed is constant so K.E remains constant.

Q.6 $v = r\omega$

$\because \omega = \frac{2\pi}{60}\,\text{rad}\,s^{-1}$

$v = 1\,cm \times \frac{2\pi}{60} = \frac{2\pi}{60}\,cm\,s^{-1}$

Q.7 $\frac{\omega}{f} = \frac{2\pi f}{f} = 2\pi$

Q.8 $\vec{v} = \vec{\omega}\times\vec{r} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 0 & 1 & 2 \\ 3 & 4 & 0 \end{vmatrix} = -8\hat{i} + 6\hat{j} - 3\hat{k} = -(8\hat{i} - 6\hat{j} + 3\hat{k})$

Q.9 $\tau = \frac{\Delta L}{\Delta t} = \frac{4}{4} = 1$ unit

Q.10 As motion is uniform so magnitude velocity remains same i.e. speed

Q.11 $\alpha = \frac{\Delta\omega}{\Delta t} = \frac{540\times2\pi}{60\times6} = \frac{540\times2\pi}{360} = 3\pi$ rad / s

Q.12 Speed of body $= v = R\omega = 1.0\times4 = 4\,ms^{-1}$. Referring to figure, we find that, when the body is at the topmost point A, the tension in the string is

$T = \frac{mv^2}{R} - mg$

$= \frac{0.5\times(4)^2}{1.0} - 0.5\times10$ Or $T_A = 8-5 = 3\,N$

Q.13 Only in circular motion, body remains at constant distance from a fixed point and constant distance is called radius.

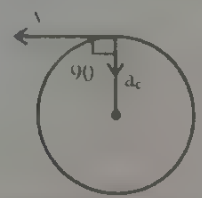
Q.14 $a_t = r\alpha$

Here a_t is tangential acceleration

Q.15 $\omega = \frac{v}{r} = \frac{16}{2} = 8\,\text{rad}\,s^{-1}$

Q.16 $120\,\text{rev/min} = 120 \times \frac{2\pi}{60}\,\text{rad/sec} = 4\pi\,\text{rad/sec}$

Q.17



Q.18 All the points on rotating body have same angular acceleration.

Q.19 A wheel rotates about an axis with slowly increasing angular speed so $\Delta\omega \neq 0$ & ... it has tangential velocity but acceleration having both component.

Q.20 According to convention in anti-clock wise rotation angular displacement is taken as ...

Q.21 $a = r\alpha \qquad \because r = \frac{d}{2} = \frac{2}{2} = 1m$

$$\alpha = \frac{a}{r} = \frac{8}{1}$$

$$\alpha = \frac{rad}{sec} = 8\,\text{rad/sec}^2$$

Q.22 $v = r\omega$

$$v = \frac{1}{2} \times \frac{30 \times 2\pi}{60}$$

$$v = \frac{\pi}{2}\,ms^{-1}$$

Q.23 $\omega_i = 0\,\text{rad}\,s^{-1}$

$$\omega_f = 300\,\text{rev/min} = 10\pi\,\text{rad}\,s^{-1}$$

$$\alpha = \frac{\omega_f - \omega_i}{t} = \frac{10\pi}{10}$$

$$\alpha = 3.14\,\text{rad}\,s^{-2}$$

Q.24 $\omega = \frac{\theta}{t} = \frac{2\pi}{24} = \frac{\pi}{12}$

Q.25 $\theta = \omega t = \frac{360 \times 2\pi}{60} \times 1$

$$\theta = 12\pi\ \text{radian}$$

Q.26 θ [illegible] $\frac{[illegible]}{60 \times 60}$

$\theta = \frac{[illegible]}{3600}$ rads

Q.27 $W = F d \cos\theta$

$\theta = 90^\circ$

$W = F d \cos 90^\circ = 0$

Q.28 Because planets are in circular motion so necessary acceleration is provid[illegible] [illegible]

Q.29 Adhesion is clinging of unlike molecules.

Q.30 At bottom [illegible] is maximum because [illegible] W + [illegible]

Q.31 When centripetal force vanishes objects moves along straight path i.e along tangent to circle

Q.32 The mud's flies off the tyre of a fast moving car in the direction tangent to the moving car.

Q.33 $\frac{a_H}{[illegible]} = \frac{\omega_H^2 \times R}{[illegible]} = \frac{T^2}{T_[illegible]} \frac{R}{[illegible]} = \frac{R}{[illegible]}$ [As $T_[illegible] = T_[illegible]$]

Q.34 $F_c = \frac{mv^2}{r}$

$= \frac{1000 \times 20^2}{100}$

$= 4.0 \times 10^3 \text{ kg m s}^{-2}$

Q.35 [illegible]

$a = r\omega^2$

mv^2

Q.36 $\frac{F_1}{F} = \frac{F_1}{mv} [illegible]$

Q.37 Work by F_c is always zero.

[illegible] $\cos\theta$

$W = F_c d \cos 90^\circ$

$W = 0$

Q.38 [illegible]

$= 0.25 \times (2 \times 2\pi)^2$

$a_c = 4\pi^2 \text{ rad s}^{-2}$

Q.39 $F = \frac{mv^2}{r}$

$v = r\omega = \frac{1 \times 30 \times 2\pi}{60} = \pi$

$F = \frac{0.25 \times \pi^2}{1}$

$F = \frac{1}{4}\pi^2 N$

Q.40 $F_c = \frac{mv^2}{r}$

$v = r\omega$

$F_c = \frac{mr^2\omega^2}{r} = mr\omega^2$

Q.41 $t = \frac{s}{v} = \frac{2\pi r}{v}$

$\because r = 4.2 \times 10^7$

$\because v = \sqrt{\frac{GM_e}{r}}$

$v = 3.07 \times 10^3 \, ms^{-1}$

$t = \frac{s}{v} = \frac{2\pi \times 10^7 \times 4.2}{3.07 \times 10^3}$

$t = 85958 \text{second} = 1432 \text{ minutes}$

Q.42 A satellite which is revolving around the earth is freely falling object. $(a = g)$

Q.43 As time period of satellite is given by

$T = \frac{2\pi R}{v}$

T is independent from mass

Q.44 $\because \left(\frac{T_2}{T_1}\right)^2 = \left(\frac{r_2}{r_1}\right)^3$

$\Rightarrow \left(\frac{T_2}{T_1}\right)^2 = \left(\frac{1}{4}\right)^3$

$\left(\frac{T_2}{T_1}\right)^2 = \frac{1}{64}$

$\frac{T_2}{T_1} = \frac{1}{8}$

$T_2 = T_1 \times \frac{1}{8} \Rightarrow \frac{365}{8} = 46 \text{days}$

Q.45 $F = mr\omega^2 = 6\times10^{24}\times1.5\times10^{11}\times(2\times10^{-7})^2$

[illegible]

Q.46 Whole of the populated Earth's surface can be covered by three correctly positioned satellites. One such satellite covers 120° of longitude.

Q.47 Since $T^2 \propto r^3 \therefore \left(\frac{T'}{T}\right)^2 = \left(\frac{1}{4}\right)^3 \Rightarrow T' = \frac{1}{8}T$

Q.48 According to Kepler's law of periods

$T^2 \propto R^3$

$(T_2/T_1)^2 = (R_2/R_1)^3 = ((R_1/2)/R_1)^3 = 1/8$

$T_2 = 1/(2\sqrt{2}) \times T_1 = 0.353 \times 365\text{days} = 129\text{days}.$

Q.49 $S = r\theta$

$2\pi r = r\theta$

$\theta = 2\pi\,\text{rad}$

Q.50 According to fundamental trigonometry it is definition of radian, when $s = r$ then $\theta = 1\,\text{rad}$.

PAST PAPER MCQ's (2008-2019)

2008

Q.1 The force required to bend the normally straight path of a particle into a circular [illegible] called __________ force.

A) Traveling
B) Bending
C) Centrifugal
D) Centripetal

2009

Q.2 Linear velocity or tangential velocity of any particle moving in a circular path of [illegible] m with angular velocity 8 rads^{-1} will be:

A) 16 ms^{-1}
B) 4 ms^{-1}
C) 10 ms^{-1}
D) 6 ms^{-1}

2010

Q.3 A wheel of radius 1 m covers an angular displacement of 180. Its linear displacemen[illegible]

A) 3.14 m
B) π rad
C) 6.28 m
D) 0.157 m

2011

Q.4 Radian is a unit of angular displacement which can also be measured in degrees. How many radians are equal to one degree?

A) $\frac{180}{\pi}$
B) $\frac{\pi}{180}$
C) $\frac{2\pi}{180}$
D) $\frac{\pi}{[illegible]}$

2017

Q.5 The moon rotates about its axis, in future, scientists may wish to put a satellite in[illegible] orbit around the moon such that satellite remains stationary above one point [illegible] moon's surface. The period of rotation of the moon about its axis is 27.4 days. [illegible] the radius of required orbit? $M_m = 7.35 \times 10^{22}$kg.

A) 3.59×10^7m
B) 4.23×10^7m
C) 6.96×10^6m
D) 8.86×10^7m

Q.6 A body moves in a circle with increasing angular velocity. At time t= 6sec, the an[illegible] velocity is 27rad/s. What is the radius of circle made by the body where linear ve[illegible] 81cm/s?

A) 6cm
B) [illegible]
C) 9cm
D) 7cm

Retake Test 2017

Q.7 Angular speed of minutes hand of mechanical watch is:

A) [illegible] rad min
B) [illegible]
C) $\pi / 2$ rad min^{-1}
D) None of these

Q.8 A body is moving in a circular path with constant speed. The magnitude of tang[illegible] and centripetal acceleration are:

	Tangetial	Centripetal
A)	[illegible]	0
B)	0	0
C)	[illegible]	v^2r
D)	[illegible]	v^2/r

2018

Q.9 A wheel starts rotating from rest with angular acceleration of 2 rad/s² till its angular speed becomes 6 rad/s. The angular displacement of the wheel will be equal to

A) [illegible]
B) [illegible]
C) [illegible]
D) [illegible]

Q.10 Which of the following gives the relationship between linear velocity and angular velocity?

A) [illegible]
B) [illegible]
C) [illegible]
D) [illegible]

2019

Q.11 An object is moving along a circular path of radius 4m. What will be its angular displacement if it moves 14m on this circular path?

A) [illegible] radians
B) 3.5 radians
C) 5.0 radians
D) 4.5 radians

ANSWER KEY

[illegible]	D	11	B
[illegible]	A		
[illegible]	A		
[illegible]	B		
[illegible]	D		
[illegible]	B		
[illegible]	A		
[illegible]	D		
[illegible]	B		
[illegible]	A		

EXPLANATORY NOTES

Q.1 Definition of centripetal force.

Q.2 $V = r\omega$

$= 2 \times 8 = 16 m/s$

Q.3

$S = r\theta \qquad \theta = 180^\circ$

$= 1 \times \pi \qquad \theta = 180^\circ \times \dfrac{\pi}{180^\circ} = \pi\, rad$

$= \pi m = 3.14 m$

Q.4

$2\pi rad = 360^\circ$

$1^\circ = \dfrac{2\pi}{360} rad$

$1^\circ = \dfrac{\pi}{180} rad$

Q.5 $r = \left(\dfrac{GMT^2}{4\pi^2}\right)^{1/3}$

$$r = \left(\frac{6.67 \times 10^{-11} \times 7.35 \times 10^{22} \times 27.4 \times (24 \times 3600)^2}{4\pi^2}\right)^{1/3} = 8.86 \times 10^7 m$$

Q.6 $v = r\omega$

$r = \dfrac{v}{\omega} = \dfrac{81}{27} = 3cm$

Q.7 $\omega = \dfrac{\theta}{t} = \dfrac{2\pi}{60} = \dfrac{\pi}{30} \dfrac{rad}{min}$

Q.8 For constant speed $\Delta v = 0$

$a_t = \dfrac{\Delta v}{\Delta t} = 0$

$a_c = \dfrac{v^2}{r}$

Q.9 $2\theta\alpha = \omega_f^2 - \omega_i^2 \quad \because \omega_i = 0$

$\theta = \dfrac{\omega_f^2}{2\alpha} = \dfrac{6^2}{2(2)} = \dfrac{36}{4} = 9 rad$

Q.10 $v = r\omega$

Q.11 $S = r\theta$

$\theta = \dfrac{S}{r} = \dfrac{14}{4} = 3.5 rad$

TOPIC-5 OSCILLATIONS

PRACTICE EXERCISE

TOPIC-WISE MCQ's

SIMPLE HARMONIC MOTION

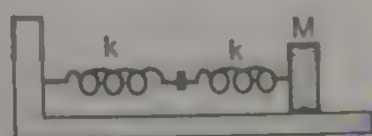
Q.1 Total distance traveled by bob of simple pendulum in one vibration is equal to

A) Amplitude
B) Twice of Amplitude
C) Square of Amplitude
D) Four Times of Amplitude

Q.2 A spring of constant K is cut into two parts by the ratio of length 1:2. The spring constant of larger one is

A) $\frac{K}{2}$
B) $\frac{2K}{3}$
C) $\frac{K}{3}$
D) $\frac{3K}{2}$

Q.3 Two springs are connected to a block of mass M placed on friction less surface as shown in the figure.



If both the spring have a spring constant k, the frequency of oscillation of block is

A) $\frac{1}{2\pi}\sqrt{\frac{k}{M}}$
B) $\frac{1}{2\pi}\sqrt{\frac{2k}{M}}$
C) $\frac{1}{2\pi}\sqrt{\frac{k}{2M}}$
D) $\frac{1}{2\pi}\sqrt{\frac{M}{k}}$

Q.4 If F = 0.08 N and x = 4 cm, then the value of 'K' is:

A) 2 $N\,m^{-1}$
B) 6 $N\,m^{-1}$
C) 4 $N\,m^{-1}$
D) 8 $N\,m^{-1}$

Q.5 A force of 20 N, applied on a elastic spring. If the extension produced in the spring is 10 cm, the spring constant of the spring is:

A) 14 $N\,m^{-1}$
B) 200 $N\,m^{-1}$
C) 18 $N\,m^{-1}$
D) 200 $N\,m^{-1}$

Q.6 A body moves with simple harmonic motion and makes n-complete oscillations in one second. What is its angular frequency?

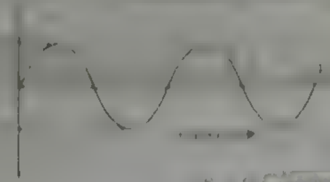
A) n $rad\,s^{-1}$
B) $\frac{1}{n}$ $rad\,s^{-1}$
C) $2\pi n$ $rad\,s^{-1}$
D) $\frac{2\pi}{n}$ $rad\,s^{-1}$

AMPLITUDE, FREQUENCY, ANGULAR FREQUENCY, PHASE DIFFERENCE. EXPRESS THE TIME PERIOD IN TERMS OF BOTH FREQUENCY AND ANGULAR FREQUENCY EQUATIONS $x = x_o \sin\omega t$, $v = v_o \cos\omega t$, $v = \pm\omega\sqrt{x_o^2 - x^2}$, $a = -\omega^2 x$ AND ITS USE

Q.7 If the period of oscillation of mass M suspended from a spring is 1 sec then the period of mass 4M will be:

A) $\frac{1}{4}$ sec
B) 2 sec
C) $\frac{1}{2}$ sec
D) 4 sec

Q.8 The diagram represents the variation of pressure with time at a point in air through which sound wave is travelling at ... What is the frequency of the wave?

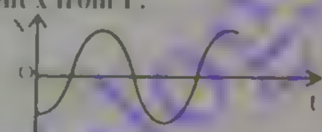


A) ...
B) 5.0×10^{2} Hz
C) $1.5\times10^{...}$ Hz
D) 3×10^{4} Hz

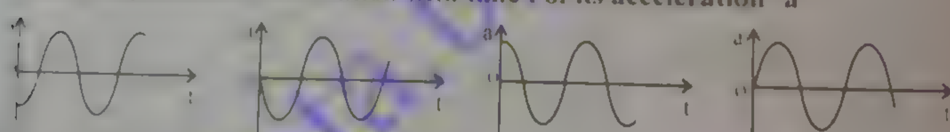
Q.9 The graph of acceleration as a function of displacement in S.H.M is
A) Straight line
B) Circle
C) Parabola
D) Ellipse

Q.10 The maximum acceleration of a body executing S.H.M is a_o and maximum velocity is v_o. The amplitude is given by:
A) $\frac{v_o}{a}$
B) $\frac{a}{v}$
C) $v_o a_o$
D) $\frac{1}{a_o v_o}$

Q.11 A body moves with simple harmonic motion about a point P. The graph shows the variation with time 't' of its displacement x from P.



Which graph shows the variation with time t of its acceleration 'a'

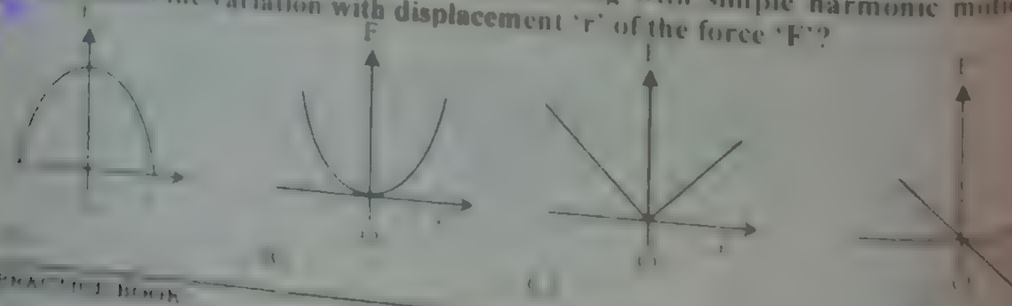


A) B) C) D)

Q.12 A body moves with SHM and makes one complete oscillation in one second. What is its angular frequency?
A) 2 rad/s
B) 1 rad/s
C) 2π rad/s
D) π rad s^{-1}

Q.13 The distance covered by a body in one complete vibration is 20 cm. What is the amplitude of body?
A) 10 cm
B) 15 cm
C) 5 cm
D) 7.5 cm

Q.14 A resultant force 'F' acts on a particle moving with simple harmonic motion. Which graph shows the variation with displacement 'r' of the force 'F'?



Q.15 Equation of a particle vibrating in SHM is $2y = 8 \sin 4\pi t$. Its amplitude and angular frequency is

A) 6 m & 2π rads
B) 32 m & 2 Hz
C) 16 m & 4 Hz
D) 4 m & 4π rads

Q.16 If a mass of 0.5kg is attached to a spring and maximum energy stored in it is 0.04J and it oscillate with a time period of π second, then the amplitude of motion will be

A) 10 cm
B) 80 cm
C) 20 cm
D) 40 cm

Q.17 Two springs have force constants in the ratio 4:9. Their time periods are in the ratio of

A) 3:2
B) 1:3
C) 2:3
D) 3:1

Q.18 The displacement equation for a particle executing SHM is given by $x = 0.25 \sin 200\, t$ cm. The maximum speed of the particle will be

A) 0.25 m s^{-1}
B) 500 cm s^{-1}
C) 100 cm s^{-1}
D) 50 cm s^{-1}

Q.19 When quarter of cycle is completed by a body in a circular motion, the phase of vibration is:

A) 0°
B) 180° (π radian)
C) 90°, $\left(\frac{\pi}{2}\text{ radian}\right)$
D) 270° $\left(\frac{3\pi}{2}\text{ radian}\right)$

Q.20 A particle executing S.H.M. has an amplitude of 6 cm. Its acceleration at a distance of 2 cm from the mean position is 8 cm s^{-2}. The maximum speed of the particle is:

A) 8 cm s^{-1}
B) 16 cm s^{-1}
C) 12 cm s^{-1}
D) 24 cm s^{-1}

Q.21 A particle executes simple harmonic motion with an angular velocity of 3.5 rad/sec and maximum acceleration 7.5 m/s^2 respectively. What is the amplitude of oscillations?

A) 0.28m
B) 0.36m
C) 0.707m
D) 0.61m

Q.22 If a simple harmonic oscillator has got a displacement of 0.02m and acceleration equal to 2m/s^2 at any time, the angular frequency of the oscillator is equal to

A) 10 rad/s
B) 0.1 rad/s
C) 100 rad/s
D) 1 rad/s

Q.23 A particle executes S.H.M. with a period of 6 second and amplitude of 3 cm. Its maximum speed in cm/sec is

A) $\pi/2$
B) 2π
C) π
D) 3π

MOTION OF SIMPLE PENDULUM AND RELATION

Q.24 A simple pendulum length 'l' is suspended from a rigid support. What minimum horizontal velocity should it be given so that bob reaches the height of support?

A) $\sqrt{gl}$
B) $\sqrt{3gl}$
C) $\sqrt{2gl}$
D) $\sqrt{5gl}$

Q.25 A simple pendulum is executing simple harmonic motion with a time period T. If the length of the pendulum is increased by 21%, the percentage increase in the time period of the pendulum of increased length is

A) 10%
B) 80%
C) 21%
D) 50%

Q.26 If the length of simple pendulum is increased by 300%, then the time period will be increased by

A) 100%
C) 200%
B) 300%
D) 400%

Q.27 The length of the seconds' pendulum on the surface of Earth is 1m. Its length on the surface of Moon, where g is $\frac{1}{6}$th the value of g on the surface of Earth, is

A) $\frac{1}{6}$ m
C) $\frac{1}{36}$ m
B) 6 m
D) 36 m

Q.28 How long must be length of a simple pendulum in order to have a period of one second

A) 1 m
C) 50 m
B) 0.25 m
D) 1.5 m

Q.29 If a hollow bob of a simple pendulum be filled with mercury that rains out slowly, its time period

A) Increases continuously
C) Decreases continuously
B) Remains same
D) First increases then decreases

Q.30 A simple pendulum suspended from ceiling of a lift has time period T when the lift is at rest. When the lift falls freely then its

A) Time period becomes zero
C) Acceleration becomes zero
B) Time period is infinite
D) Frequency becomes infinity

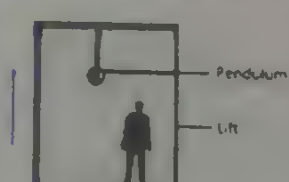
Q.31 A pendulum clock is taken into a mine from surface of the earth. Its time periods

A) Decreases
C) Increases
B) Remains same
D) None of these

Q.32 A simple pendulum is oscillating in a lift. If lift starts moving upward with acceleration its period will

A) Increase
C) Remains same
B) Decrease
D) Cannot produced

Q.33 A man measures the period of a simple pendulum inside a stationary lift and finds it to be T sec. If the lift accelerates upwards with an acceleration g/4, then the period of the pendulum will be



A) 2T
C) T/4
B) $\frac{2T}{\sqrt{5}}$
D) $2T\sqrt{5}$

Q.34 A simple pendulum executing S.H.M. is falling freely along with the support in an elevator. Then

A) its periodic time decreases
C) its periodic time increases
B) it does not oscillate at all
D) none of these

Q.35 When bob of a simple pendulum is at mean position the value of P.E. is:

A) Maximum
C) Minimum
B) Zero
D) None of these

Q.36 When the length of simple pendulum is doubled, then ratio of its new time period to old time period is:

A) $2\sqrt{2}$

B) $-\sqrt{2}$

C) $\sqrt{2}$

D) $1\sqrt{2}$

Q.37 A hollow spherical pendulum is filled with mercury has time period T. If mercury is thrown out completely, then the new time period

A) Increases

B) Decreases

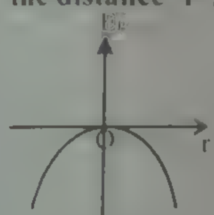
C) Remains the same

D) First increases and then decreases

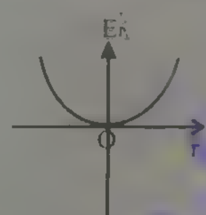
KINETIC ENERGY AND POTENTIAL ENERGY DURING SIMPLE HARMONIC MOTION

Q.38 A particle is moving such that the force F on it changes with distance 'r' from a fixed point as shown

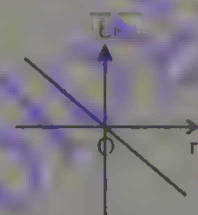
Which graph best shows the relationship between potential energy E_P of the particle and the distance 'r'?



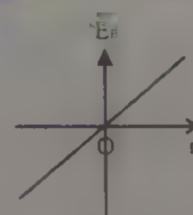
A)



B)



C)



D)

Q.39 For what displacement the P.E becomes $\frac{1}{4}$ of its maximum value?

A) $x = x_o$

B) $x = \frac{x_o}{4}$

C) $x = \frac{x_o}{2}$

D) $x = \frac{x_o^2}{2}$

Q.40 The kinetic energy of a particle executing S.H.M. is 16 J when it is at its mean position. If the mass of the particle is 0.32 kg, then what is the maximum velocity of the particle

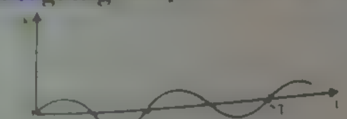
A) 5 m/s

B) 20 m/s

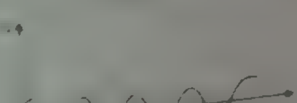
C) 15 m/s

D) 10 m/s

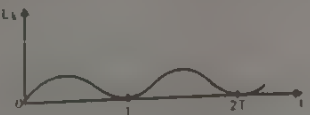
Q.41 Which graph correctly shows the variation with time 't' of kinetic energy E_K of an object undergoing simple harmonic motion of period T?



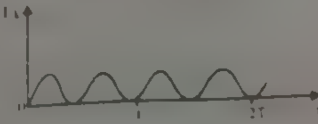
A)



B)



C)



D)

Q.42 There is a body having mass m and performing S.H.M. with amplitude a. There is a restoring force $F = -Kx$, where x is the displacement. The total energy of body depends upon
A) K, x
B) K, a, v
C) K, a, x
D) K, a

Q.43 A particle is executing simple harmonic motion at midpoint of mean position and extreme position. What is the potential energy in terms of total energy (E)?
A) E/4
B) E/16
C) E/2
D) E/8

FREE, FORCED AND DAMPED OSCILLATIONS

Q.44 The amplitude of a vibrating body situated in a resistive medium
A) Decreases linearly with time
B) Decreases exponentially
C) Remain constant with time
D) inversely proportional to time

Q.45 A heavily damped system has a fairly flat resonance curve in:
A) Distance time graph
B) An acceleration time graph
C) Velocity time graph
D) An amplitude frequency graph

Q.46 Damping is the process whereby energy is lost from the
A) Body
B) String
C) Oscillating system
D) All of these

RESONANCE

Q.47 In case of a forced vibration, the resonance wave becomes very sharp when the
A) applied periodic force is small
B) damping force is small
C) quality factor is small
D) restoring force is small

Q.48 Electrical resonance is observed in
A) Radio
B) Both in Radio and microwave oven
C) Microwave oven
D) Neither in Radio nor in microwave oven

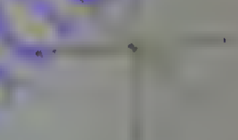
Q.49 Tuning a radio is an example
A) Natural resonance
B) Free resonance
C) Mechanical resonance
D) Electrical resonance

Q.50 Resonance occurs when one of the natural frequencies of vibration of the forced driven harmonic oscillator
A) Greater than the frequency of applied force
B) Equal to the frequency of applied force
C) Less than the frequency of applied force
D) All of them

ANSWER KEY

1	D	11	C	21	D	31	C	41	D
2	D	12	C	22	A	32	B	42	D
3	C	13	C	23	C	33	B	43	A
4	A	14	D	24	C	34	B	44	B
5	B	15	D	25	A	35	B	45	D
6	C	16	C	26	A	36	C	46	C
7	B	17	A	27	A	37	C	47	B
8	B	18	D	28	B	38	B	48	B
9	A	19	C	29	D	39	C	49	D
10	A	20	C	30	B	40	D	50	B

EXPLANATORY NOTES



Q.11 Phase difference between a and x in S.H.M is 180°

i.e. $a \propto -x$

Q.12 $\omega = 2\pi f$

$\omega = 2\pi(1) = 2\pi \text{ rad s}^{-1}$

Q.13 In one complete vibration

$S = 4x_o$

$x_o = \frac{S}{4} = \frac{20}{4} = 5 \text{ cm}$

Q.14 $F = -Kx \Rightarrow F \propto -x$

Q.15 $2y = 8\sin 4\pi t$

$y = 4\sin 4\pi t$.....(i)

$x = x_o \sin \omega t$.....(ii)

Comparing equation (i) and (ii)

$x_o = 4 \text{ m}$

$\omega = 4\pi \text{ rad s}^{-1}$

Q.16 $\because T = 2\pi\sqrt{\frac{m}{k}}$

$\Rightarrow T = 2\pi\sqrt{\frac{m}{k}}$

$\frac{1}{2} = \sqrt{\frac{m}{k}} \Rightarrow \frac{1}{4} = \frac{m}{k}$

$k = m(4) = 0.5 \times 4 = 2 \text{ N m}^{-1}$

$\frac{1}{2}kx_o^2 = P.E_{max}$

$\frac{1}{2}(2)x_o^2 = 0.04 \Rightarrow x_o = 0.2 \text{ m} = 20 \text{ cm}$

Q.17 $T = 2\pi\sqrt{\frac{m}{K}} \Rightarrow T \propto \sqrt{\frac{1}{K}}$

$\frac{T_1}{T_2} = \frac{\sqrt{K_2}}{\sqrt{K_1}} = \sqrt{\frac{9}{4}} = \frac{3}{2}$

Q.18 As. $v = x_o\omega = 0.25 \times 200 = \frac{1}{4} \times 200 = 50 \text{ cm s}^{-1}$

Q.19 After completing quarter cycle body is at extreme position.

i.e $\theta = 90^\circ$ OR $\frac{\pi}{2}$ rad

Q.20 $v_o = \omega x_o$

$\omega = \sqrt{\frac{a}{x}} \Rightarrow v_o = \sqrt{\frac{a}{x}}x_o = \sqrt{\frac{8}{2}} \times 6 = 2 \times 6 = 12 \text{ cm s}^{-1}$

Q.21 [illegible]

[illegible] 7.5(3.5 - 3.5) = 0.61 m

Q.22 [illegible]

$\omega^2 = a/y = 2/0.02 = 100$

$\omega = 10 \text{rad/s}.$

Q.23 [illegible] $\left(\frac{2\pi}{T}\right) = 3\left(\frac{2\pi}{6}\right) = \pi \, \text{cm s}^{-1}$

Q.24 Loss in K.E = Gain in P.E

$\frac{1}{2}mv^2 = mg\ell \quad \because h = \ell$

$v = \sqrt{2g\ell}$

Q.25 $\%\ell' = 100\%\ell + 21\%\ell$

$\%\ell' = 121\%\ell$

or $\ell' = 1.21\ell$

$\frac{T'}{T} = \sqrt{\frac{\ell'}{\ell}} \Rightarrow \frac{T'}{T} = \sqrt{\frac{1.21\cancel{\ell}}{\cancel{\ell}}}$

$T' = \sqrt{1.21}T = 1.1T$

%age increase in $T = \frac{T' - T}{T} \times 100 = \frac{1.1T - T}{T} \times 100 = 0.1 \times 100 = 10\%$

Q.26 $\%\ell' = 100\%\ell + 300\%\ell$

$\%\ell' = 400\%\ell$

or $\ell' = 4\ell$

$\frac{T'}{T} = \sqrt{\frac{\ell'}{\ell}} \Rightarrow \frac{T'}{T} = \sqrt{\frac{4\cancel{\ell}}{\cancel{\ell}}}$

$T' = \sqrt{4}T = 2T$

%age increase in $T = \frac{T' - T}{T} \times 100 = \frac{2T - T}{T} \times 100 = 1 \times 100 = 100\%$

Q.27 $T = 2\pi\sqrt{\frac{\ell}{g}} \Rightarrow \ell \propto g \quad [T = \text{constant}]$

At moon.

$\frac{g}{6} \quad \frac{\ell}{6}$

Length of second pendulum at moon $= \frac{\ell}{6} = \frac{1}{6}\text{m}$

$T = 2\pi\sqrt{\frac{\ell/6}{g/6}} = 2\text{sec}$

Q.28 $T = 2\pi\sqrt{\frac{\ell}{g}} \Rightarrow T^2 = 4\pi^2\left(\frac{\ell}{g}\right)$

[illegible]

Q.29 Length of simple pendulum first increase then decrease due to change in centre of mass

$\because T = 2\pi\sqrt{\frac{\ell}{g}} \Rightarrow T \propto \sqrt{\ell}$

Q.30 $T = 2\pi\sqrt{\frac{l}{g-a}}$

During free falling $a = g$

$T = 2\pi\sqrt{\frac{l}{g-g}}$

Q.31 $T = 2\pi\sqrt{\frac{l}{g}}$

$T \propto \frac{1}{\sqrt{g}}$

From surface of earth to center of earth 'g' decreases. So 'T' increases

Q.32 When lift accelerating upward $T = 2\pi\sqrt{\frac{l}{g+a}}$ so time period will decrease.

Q.33 In stationary lift $T = 2\pi\sqrt{\frac{l}{g}}$

In upward moving lift $T' = 2\pi\sqrt{\frac{l}{g+a}} = 2\pi\sqrt{\frac{l}{g+\frac{g}{4}}} = \sqrt{\frac{4}{5}}\left(2\pi\sqrt{\frac{l}{g}}\right) = \sqrt{\frac{4}{5}}T$

Q.34 $T = 2\pi\sqrt{\frac{l}{g-a}}$

During free falling, $a = g$

$T = 2\pi\sqrt{\frac{l}{g-g}}$

So $T = \infty$ it means that pendulum does not oscillate at all.

Q.35 [illegible]

Q.36 [illegible]

Q.37 [illegible]

Q.38 At extreme position P.E is maximum and at mean position P.E is minimum (i.e 0)

Q.39 $P.E = \frac{1}{2}Kx^2$

$= \frac{1}{2}K\left(\frac{x_o}{2}\right)^2 \qquad \left(\because x = \frac{x_o}{2}\right)$

$= \frac{1}{4}\times\left(\frac{1}{2}Kx_o^2\right)$

$P.E = \frac{1}{4}P.E_{max}$

Q.40 $K.E = \frac{1}{2}mv_o^2 \Rightarrow v_o = \sqrt{\frac{2K.E}{m}} = \sqrt{\frac{2\times16}{0.32}} = \sqrt{100} = 10\ ms^{-1}$

Q.41 In S.H.M. K.E becomes two times maximum in one vibration.

Q.42 $T.E = \frac{1}{2}Kx_o^2$ where $x_o = a$

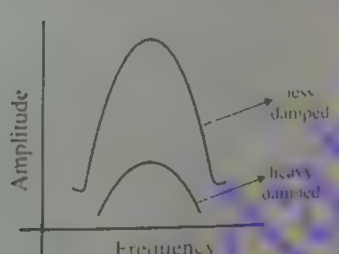
Q.43 At $y = A/2$,

Potential energy $= 1/2 \times kx^2$

Potential energy $= 1/2 \times k \times A^2/2^2 = 1/4 \times 1/2 \times k \times A^2 = 1/4 \times E$

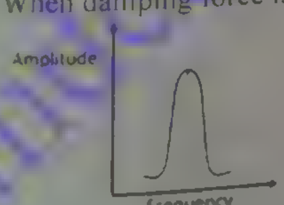
Q.44 In damping case, amplitude of vibrating body decreases exponentially.

Q.45



Q.46 In damping process amplitude of vibrating body continiously decrease. its energy loss due to decreasing amplitude.

Q.47 When damping force is small, then resonance wave become very sharp.



Q.48 Radio and microwave oven are practical examples of electrical resonance.

Q.49 Tuning of radio is an example of electrical resonance.

Q.50 Resonance occurs when two different frequencies becomes equal

PAST PAPER MCQ's (2008-2019)

Q.1 If the mass of the bob of a pendulum is doubled its time period is:
A) Halved
B) Doubled
C) Unchanged
D) Increases four times

Q.2 Tuning of the radio is the best example of electrical ________
A) Resonance
B) Resistance
C) Current
D) None of these

Q.3 The angular frequency of simple pendulum is directly proportional to ________
A) l
B) $1/l$
C) $\sqrt{l}$
D) $\sqrt{1/l}$

Q.4 The acceleration is proportional to the displacement and is directed towards mean position in __________ motion.
A) Gravity
B) Simple harmonic
C) Uniform
D) Projectile

2009

Q.5 If the mass attached with a spring becomes four times, the time period of vibration becomes:
A) One fourth
B) 3/4
C) Half
D) Double

2010

Q.6 An oscillating body is at mean position at t = 0. At t = T/4 it will be at
A) Extreme position
B) Mean position
C) Between extreme and mean position
D) Beyond extreme position

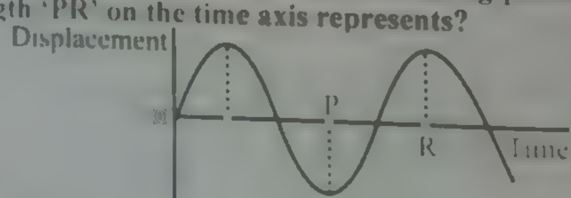
Q.7 In a simple pendulum, the tension of the string is
A) g cos θ
B) mg sin θ
C) mg cos θ
D) mg

2011

Q.8 What is the period of mass spring system during SHM if the ratio of mass to spring constant is ¼?
A) π
B) 2π
C) 1/π
D) ½π

2012

Q.9 In the diagram below, the displacement of an oscillating particle is plotted against time. What does the length 'PR' on the time axis represents?



A) Twice the frequency
B) Half the period
C) Half the frequency
D) Twice the period

Q.10 A simple harmonic oscillator has a time period of 10 seconds. Which equation relates its acceleration 'a' and displacement 'x'?

A) $a = -10x$

B) $a = -(20\pi)x$

C) $a = -\left(\frac{2\pi}{10}\right)^2 x$

D) $a = -(20\pi)^2 x$

Q.11 When the length of a simple pendulum is doubled, find the ratio of the new frequency to the old frequency?

A) $\frac{1}{4}$

B) $\frac{1}{2}$

C) $\sqrt{2}$

D) $\frac{1}{\sqrt{2}}$

2013

Q.12 For vibrating mass-spring system, the expression of kinetic energy at any displacement 'x' is given by:

A) $\frac{1}{2}mw\left(x_0^2 - x^2\right)$

B) $\frac{1}{2}kx_o^2$

C) $\frac{1}{2}kx^2\left(1 - \frac{x^2}{x^2}\right)$

D) $\frac{1}{2}mw^2x_o$

Q.13 In a simple Harmonic Motion with a radius 'x_o', the velocity of the particle at any point is:

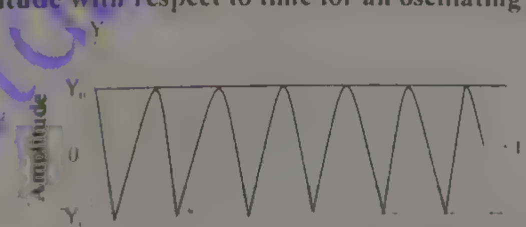
A) $v = \omega\sqrt{x_o^2 - x^2}$

B) $v = \omega\left(x^2 - x_0^2\right)$

C) $v = \omega\sqrt{x_o - x}$

D) $v = \omega\sqrt{(x - x_o)}$

Q.14 Variation of amplitude with respect to time for an oscillating object is shown in figure.



A) Damped

B) Critical

C) Un-damped

D) Heavily damped

2014

Q.15 Food being cooked in microwave oven is an example of

A) Beats

B) Overtones

C) Resonance

D) Stationary waves

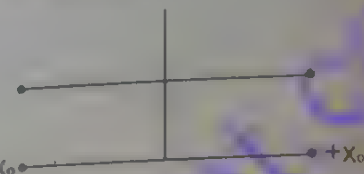
Q.16 Potential energy of a mass spring system with respect to displacement in simple harmonic motions (SHM) is shown in the figure.

Which of the following represents the total energy of mass spring system during SHM?

A) 

C) 

B) 

D) 

Q.17 Frequency of simple pendulum of length 9.8 m will be

A) 2π *Hertz*

C) $\frac{1}{2\pi}$ *Hertz*

B) $\frac{\pi}{2}$ *Hertz*

D) $\frac{\pi}{4}$ *Hertz*

Q.18 A body performs simple harmonic motion with a period of 0.063s. The maximum speed of the body is 3.0 ms^{-1}. What are the values of the amplitude x_o (m) and angular frequency ω ($rads^{-1}$)?

A) $x_o = 0.03$, $\omega = 100$

C) $x_o = 5.3$, $\omega = 16$

B) $x_o = 0.19$, $\omega = 16$

D) $x_o = 3.3$, $\omega = 100$

2015

Q.19 Mathematical formula of maximum velocity (v_o) for a body executing simple harmonic motion is

A) $v_o = \omega x_o$

C) $v_o = v\sqrt{1 - \frac{x2}{x_o^2}}$

B) $v_o = \frac{k}{m}\sqrt{x_o^2 - x^2}$

D) $v_o = \omega\sqrt{x_o^2 - x^2}$

Q.20 What should be the length of a simple pendulum whose period is 6.28 second at a place where $g = 10\ ms^{-2}$

A) 9.8 m

C) 6.28 m

B) 10.8 m

D) 10 m

Q.21 What should be the ratio of kinetic energy to total energy for simple harmonic oscillator?

A) $\left(1 - \frac{x^2}{x_o^2}\right)$

C) $(x_o^2 - x^2)$

B) 1

D) $\frac{1}{2}x^2$

Q.22 **Resonance occurs when the driving frequency is**

A) Greater than natural frequency
B) Less than natural frequency
C) Unequal the natural frequency
D) Equal to the natural frequency

Q.23 The time period 'T' of a simple pendulum depends on its length 'l' and acceleration due to gravity 'g' using unit or dimension the correct equation for time period is

A) $T = k\sqrt{\frac{g}{l}}$ where 'k' is constant
B) $T = k\sqrt{\frac{l}{g}}$ where 'k' is constant
C) $T = \frac{1}{k}\sqrt{\frac{l}{g}}$ where 'k' is constant
D) $T = \frac{1}{k}\sqrt{\frac{g}{l}}$ where 'k' is constant

Q.24 Tuning a radio is an example

A) Natural resonance
B) Free resonance
C) Mechanical resonance
D) Electrical resonance

2017

Q.25 Angular displacement of a point moving in circle of radius 10cm, when displacement of projection of this point along vertical diameter of circle is 8.66cm, will be:

A) 30°
B) 45°
C) 75°
D) 60

Q.26 A body performing SHM with displacement $x = x_o \sin(\omega t + \phi)$ when $t = 0$, $x = x_o$. What is the value of phase angle ϕ?

A) π
B) $\pi/4$
C) $-\pi$
D) $\pi/2$

Q.27 In mass spring system, mass 'm' is attached with spring of constant 'k' with time period 'T_1' then mass is replaced by '2m' with the same spring. What will be the time period 'T_2'?

A) $T_2 = \sqrt{2}T_1$
B) [illegible]
C) $T_2 = 2T_1$
D) $T_2 = T_1/\sqrt{2}$

Retake Test 2017

Q.28 A particle executes S.H.M with frequency f. The frequency of variation of its maximum or minimum kinetic energy is:

A) f/2
B) f
C) 2f
D) 4f

Q.29 The vertical extension in a light spring by a weight of 1 kg suspended from the wire is 9.8cm, the period of the oscillation is:

A) [illegible] sec
B) [illegible] sec
C) $\frac{2\pi}{10}$
D) 2π sec

Q.30 The velocity and acceleration of a particle performing S.H.M have a steady phase relationship. The acceleration shows a phase lead over the velocity of:

A) [illegible]
B) π
C) $\pi/2$
D) $\frac{\pi}{4}$

[illegible]

Q.31 In S.H.M the kinetic energy of the body is maximum when
A) [illegible] at mean position
B) [illegible] at extreme position from the mean.
C) [illegible] way down between mean and extreme position
D) [illegible] somewhere between mean and extreme position

Q.32 **If the time period of the oscillation is 20 mirco-sec, than what will be the frequency of that oscillating body?**
A) [illegible] Hz
B) [illegible] Hz
C) 20000 Hz
D) 1000 Hz

Q.33 **Simple Harmonic Motion of a body is described by which statements mentioned below:**
K. K.E is maximum when displacement x= 0
L : P.E is maximum when x=0
M : P.E is maximum when $x = \pm x_o$
A) K and L
B) K and M
C) K, L and M
D) L and M

Q.34 **When the frequency of the applied force becomes equal to one of natural frequencies of body then the body oscillates with maximum displacement this phenomenon is called.**
A) Heating
B) Resonance
C) Reverberation
D) Damping

2019

Q.35 **When the length of simple pendulum is doubled, then ratio of its new time period to old time period is:**
A) $2\sqrt{2}$
B) $-\sqrt{2}$
C) $\sqrt{2}$
D) $1\sqrt{2}$

Q.36 **In simple harmonic motion, acceleration will be maximum, when object is at:**
A) Maximum displacement from the mean position
B) Center position
C) Mean position
D) Half of the maximum displacement from mean position

ANSWER KEY

1	C	11	D	21	A	31	A
2	A	12	C	22	D	32	B
3	D	13	A	23	B	33	B
4	B	14	C	24	D	34	B
5	D	15	C	25	D	35	C
6	A	16	D	26	D	36	A
7	C	17	C	27	A		
8	A	18	A	28	C		
9	B	19	A	29	C		
10	C	20	D	30	B		

EXPLANATORY NOTES

Q.1 $T = 2\pi\sqrt{\frac{l}{g}}$ Relation shows that time period of simple pendulum is independent of the mass of the bob.

Q.2 Tuning of the radio is bet example of electrical resonance

Q.3 $\omega = 2\pi f = 2\pi\left(\frac{1}{2\pi}\sqrt{\frac{g}{\ell}}\right)$

$\omega \propto \frac{1}{\sqrt{\ell}}$

Q.4 $a\alpha - x$, This relation is in S.H.M

Q.5 $T = 2\pi\sqrt{\frac{m}{k}}$

$m' = 4m$

$T' = 2\pi\sqrt{\frac{4m}{k}} = 2\left(2\pi\sqrt{\frac{m}{k}}\right)$

$T' = 2T$

Q.6 In S.H.M an oscillating body is at mean position t=0, then at t=T/4 (extreme position)

Q.7 In simple pendulum $T = mg\cos\theta$

Q.8 $\frac{m}{k} = \frac{1}{4}$

$T = 2\pi\sqrt{\frac{m}{k}} = 2\pi\sqrt{\frac{1}{4}} = 2\pi \times \frac{1}{2} = \pi s$

Q.9 PR is a half cycle from diagram so time period will be half.

Q.10 $a = -\omega^2 x = -\left(\frac{2\pi}{T}\right)^2 x = -\left(\frac{2\pi}{10}\right)^2 x$

Q.11 $f = \frac{1}{2\pi}\sqrt{\frac{g}{\ell}} \Rightarrow f' = \frac{1}{2\pi}\sqrt{\frac{g}{2\ell}}$

$\frac{f'}{f} = \frac{\frac{1}{2\pi}\sqrt{\frac{g}{2\ell}}}{\frac{1}{2\pi}\sqrt{\frac{g}{\ell}}} = \frac{1}{\sqrt{2}}$

Q.12 $K.E = \frac{1}{2}Kx_0^2\left(1 - \frac{x^2}{x_0^2}\right)$

Q.13 Instantaneous velocity of S.H.M is given by $v = \omega\sqrt{x_0^2 - x^2}$.

Q.14 For undamped oscillation, amplitude remain same.

Q.15 Cooking in microwave oven is example of resonance.

Q.16 T.E remains constant.

Q.17 $f = \frac{1}{2\pi}\sqrt{\frac{g}{\ell}} = \frac{1}{2\pi}\sqrt{\frac{9.8}{9.8}} = \frac{1}{2\pi}$ Hz

Q.18 $\omega = \frac{2\pi}{T} = \frac{6.28}{0.063} = 100$

$v_o = \omega x_o \Rightarrow 3 = x_o\left(\frac{2\pi}{T}\right) \Rightarrow x_o = 3\left(\frac{0.063}{2(3.14)}\right) = 0.03\text{m}$

Q.19 Maximum velocity of S.H.M is $v_o = \omega x_o$.

Q.20 $T = 2\pi\sqrt{\frac{\ell}{g}} \Rightarrow \ell = \frac{gT^2}{4\pi^2} = \frac{10(6.28)^2}{4(3.14)^2} = 10\text{m}$

Q.21 $\frac{K.E}{T.E} = \frac{\frac{1}{2}Kx_o^2\left(1 - \frac{x^2}{x_o^2}\right)}{\frac{1}{2}Kx_o^2} = \left(1 - \frac{x^2}{x_o^2}\right)$

Q.22 At resonance $f_{driving} = f_{natural}$.

Q.23 $T = k\sqrt{\frac{l}{g}}$ where 'k' is constant. Dimension analysis doesn't give any information about k.

Q.24 Tuning a radio is an example of electrical resonance.

Q.25 $\frac{x}{x_o} = \sin\theta$

$\frac{8.66}{10} = \sin\theta$

$\theta = \sin^{-1}(0.866) \Rightarrow \theta = 60^\circ$

Q.26 $x = x_o$ at t=0, body start from extreme position. $x = x_o \sin\left(\omega t + \frac{\pi}{2}\right) \Rightarrow \phi = \frac{\pi}{2}$.

Q.27 $T = 2\pi\sqrt{\frac{m}{k}}$ for same spring, $\frac{T_1}{T_2} = \sqrt{\frac{m_1}{m_2}} = \sqrt{\frac{m}{2m}} = \frac{1}{\sqrt{2}} \Rightarrow T_2 = \sqrt{2}T_1$.

Q.28 K.E= 2f

Q.29 $T = 2\pi\sqrt{\frac{x}{g}} = 2\pi\sqrt{\frac{9.8}{100 \times 9.8}} = 2\pi \times \frac{1}{10} = \frac{2\pi}{10}$ s

Q.30 In SHM acceleration lead the velocity by $\pi/2$.

Q.31 $K.E = \frac{1}{2}kx_o^2\left(1 - \frac{x^2}{x_o^2}\right), x = 0, K.E = \frac{1}{2}kx_o^2 = \max$

Q.32 $f = \frac{1}{T} = \frac{1}{20 \times 10^{-6}} = \frac{1000000}{20} = 50000\,\text{Hz}$

Q.33 L is wrong at $x = 0$.

Q.34 $f_{applied} = f_{natural}$ (resonance occured)

Q.35 $T \propto \sqrt{\ell} \Rightarrow T' \propto \sqrt{\ell'}$ here $\ell' = 2\ell$ then $T' = \sqrt{2}T$

Q.36

$x = x_o \Rightarrow a_{max} = -\omega^2 x$

TOPIC-6 WAVES

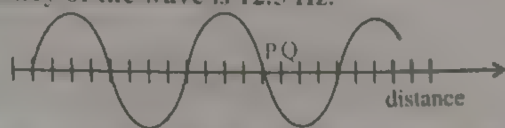
PRACTICE EXERCISE

TOPIC-WISE MCQ's

PROGRESSIVE WAVES

TRANSVERSE AND LONGITUDINAL WAVES

Q.1 The diagram shows a transverse wave at a particular instant. The wave is traveling to the right. The frequency of the wave is 12.5 Hz.



At the instant shown the displacement is zero at point 'P'. What is shortest time to elapse before the displacement is zero at point 'Q'?

A) 0.01 s
B) 0.08 s
C) 0.03 s
D) 0.10 s

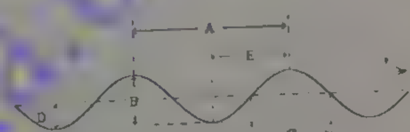
Q.2 In a transverse wave the distance between a crest and a trough is equal to

A) $\frac{\lambda}{2}$
B) λ
C) $\frac{\lambda}{4}$
D) 2λ

Q.3 If a wave travelling at a speed of 130 m/s and has a wavelength of 5m. Then find out the frequency of the wave?

A) 650 Hz
B) 20 Hz
C) 3.8×10^2 Hz
D) 26 Hz

Q.4 A sinusoidal wave is traveling toward the right as shown. Which letter correctly labels the amplitude of the wave?



A) A
B) D
C) B
D) C

Q.5 The sound of lightning flash is heard 3 second after the flash is seen. The distance of the lightning is 1020 metre. The speed of sound is:

A) 340 m/s
B) 332 m/s
C) 1400 m/s
D) none of these

Q.6 When water waves pass from deep water into shallow water how do the frequency, wave length and speed change

Frequency	Wavelength	Speed
A) Increases	Decreases	No change
B) No change	Decreases	Decreases
C) No change	Increases	Increases
D) None of these		

Q.7 Which of the following waves can be transmitted through solids, liquids and gases?

A) Transverse waves
B) Electromagnetic waves
C) Mechanical waves
D) Longitudinal waves

Q.8 If two sound waves having a phase difference of 60°, then they will have a path difference of

A) $\frac{\lambda}{6}$
C) λ
B) $\lambda/3$
D) 3λ

PRINCIPLE OF SUPERPOSITION

Q.9 For beats to be produced

A) Frequency of sources should be different and amplitude should be the same
B) Frequency of sources should be same and amplitude should be different
C) Frequency of sources should be same and amplitude should be different
D) Frequency of sources should be same and amplitude should be the same

STATIONARY WAVES AND WAVELENGTH OF SOUND WAVES IN AIR COLUMNS AND STRETCHED STRINGS

Q.10 The frequency of the first harmonic of a string stretched between two points is 100 Hz. The frequency of the third overtone is

A) 200 Hz
C) 400 Hz
B) 300 Hz
D) 600 Hz

Q.11 The fundamental frequency of a closed organ pipe is 50 Hz. The frequency of the second overtone is

A) 100 Hz
C) 200 Hz
B) 150 Hz
D) 250 Hz

Q.12 With the increase in temperature, the frequency of the sound from an organ pipe

A) decreases
C) remains unchanged
B) increases
D) none of these

Q.13 The frequency of the fundamental mode of vibration of an open organ pipe is 400 Hz. If one end of the pipe is closed, the fundamental frequency will be

A) 200 Hz
C) 600 Hz
B) 400 Hz
D) 800 Hz

Q.14 An organ pipe, open at both ends and another organ pipe, closed at one end, will resonate with each other, if their lengths are in ratio of

A) 1 : 1
C) 2 : 1
B) 1 : 4
D) 1 : 2

Q.15 "Stationary waves" are so called because in them

A) the particles of the medium are not disturbed
B) the particles of the medium do not execute SHM
C) there occurs no flow of energy along the wave
D) the interference effect can't be observed

Q.16 The frequency of the nth mode of vibration of a string stretched by a tension T and having mass m and length is given by

A) $f_n = \frac{n}{2}\sqrt{\frac{T}{m\ell}}$
C) $f_n = \frac{n}{2\ell}\sqrt{\frac{T}{m}}$
B) $f_n = \frac{n}{2}\sqrt{\frac{\ell T}{m}}$
D) $f_n = \frac{n}{2}\sqrt{\frac{T}{m}}$

Q.17 If the string vibrates in 'n' loops, the wavelength is given by

A) $\lambda_n = \frac{2}{nl}$
C) $\lambda_n = \frac{l}{2n}$
B) $\lambda_n = \frac{2l}{n}$
D) none of these

Q.18 **A cylindrical tube, open at both ends has a fundamental frequency f in air. The tube is dipped vertically in water so that half of it is in water. The fundamental frequency of air column is now:**

A) f/2
B) 3f/4
C) f
D) 2f

Q.19 **If the successive overtones of a vibrating string clamped at its ends are 280 Hz and 350 Hz, the frequency of fundamental is:**

A) 380 Hz
B) 280 Hz
C) 140 Hz
D) 70 Hz

Q.20 **If the number of loops of a stationary wave are increasing, then**

A) λ increases
B) λ decreases
C) λ remains same
D) λ may increase or decrease

Q.21 **A string of length 2m fixed between two supports vibrates in two loops. The distance between node and antinode is:**

A) 50 cm
B) 200 cm
C) 100 cm
D) 10 cm

Q.22 **The distance between two particles in a wave motion in the same phase is**

A) $\frac{\lambda}{4}$
B) $\frac{3\lambda}{4}$
C) $\frac{\lambda}{2}$
D) λ

Q.23 **The phase between two consecutive antinodes is:**

A) $\frac{\pi}{4}$
B) π
C) $\frac{\pi}{2}$
D) 2π

Q.24 **When the string vibrates in three loops then the length 'l' of the string is expressed as**

A) $l = \frac{3\lambda}{4}$
B) $l = \frac{\lambda}{2}$
C) $l = \frac{3\lambda}{2}$
D) $l = \frac{2\lambda}{3}$

Q.25 **When a source of sound is in motion towards a stationary observer then change in wave?**

A) Increase in the velocity of sound
B) Decrease in the velocity of sound
C) Increase in frequency of sound
D) Increase in both velocity and frequency of sound

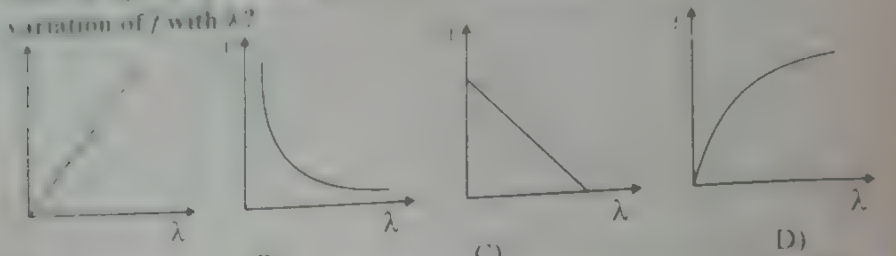
Q.26 **Overtones produced by a closed-end organ pipe are**

A) f, 3f, 5f, ...
B) [illegible]
C) 2f, 3f, 4f, ...
D) f, 2f, 3f, ...

Q.27 **The first resonance length in a closed pipe is 20 cm then second resonance occurs at**

A) [illegible]
B) [illegible]
C) 120 cm
D) 80 cm

Q.28 A sound wave of frequency f and wavelength λ travels through air. It may be assumed that its speed is independent of the frequency. Which graph correctly shows the variation of f with λ?



A) B) C) D)

Q.29 The stationary longitudinal waves in a pipe closed at one end, only ______ harmonics are present.

A) even
B) just multiple of 5
C) odd
D) all of these

Q.30 Consider a stretched string under tension and fixed at both ends. If the tension is doubled and the cross-sectional area halved, then the frequency becomes

A) Twice
B) Four times
C) Half
D) Eight times

Q.31 When the antinodes are all at their extreme displacements, the energy stored is

A) K.E
B) thermal energy
C) P.E
D) all of these

Q.32 The organ pipe which is open at both ends is

A) weaker in harmonics
B) no harmonics produce
C) richer in harmonics
D) none of these

Q.33 Progressive waves of frequency 300 Hz are superimposed to produce a system of stationary waves in which adjacent nodes are 1.5 m apart. What is the speed of the progressive waves?

A) 100 m s^{-1}
B) 900 m s^{-1}
C) 450 m s^{-1}
D) 200 m s^{-1}

Q.34 A tube closed at one end and containing air produces, when excited, the fundamental note of frequency 512Hz. If the tube is open at both ends, the fundamental frequency that can be excited is (in Hz).

A) 1024
B) 512
C) 256
D) 128

DOPPLER'S EFFECT

Q.35 When an observer moves towards source with a velocity u_o, then the modified frequency 'f_A' becomes

A) $f_A = f(v-u_o)$
B) $f_A = \left(\frac{v+u_o}{2}\right)f$
C) $f_A = f\left(\frac{v+u_o}{v}\right)$
D) $f_A = \left(\frac{v-u_o}{V}\right)f$

Q.36 **Doppler's effect is not applicable for:**

A) Microwaves
B) [illegible]
C) [illegible]
D) [illegible]

Doppler shift in frequency does not depend upon
A) The actual frequency of the wave
B) The distance of the source from the listener
C) The velocity of the source
D) The velocity of the observer

Q.38 **The source is moving towards a stationary observer then the pitch of the sound will**
A) Sometimes increases and sometimes decreases
B) Remains constant
C) Decrease
D) Increase

Q.39 **An observer standing at the sea coast observes 54 waves reaching the coast per minute. If the wavelength of the waves is 10 m, find the velocity.**
A) 3 m/s
B) 4 m/s
C) 9 m/s
D) 5 m/s

Q.40 **The apparent frequency of the whistle of an engine changes in the ratio 6:5 as engine passes a stationary observer. If the speed of sound is 352 m/s. Then the speed of engine will be**
A) 22 m/s
B) 32 m/s
C) 27 m/s
D) 36 m/s

Q.41 **A source of sound moves towards a stationary observer with a speed one third that of sound. If the frequency of the sound from the source is 100 Hz, the apparent frequency of the sound heard by the observer is**
A) 67 Hz
B) 150 Hz
C) 100 Hz
D) 75 Hz

Q.42 **If a Radar system designed in accordance with the Doppler's effect, if an airplane is moving away from a Radar, the wavelength of the reflected wave from the air plane would be:**
A) Smaller than the transmitting wave
B) Larger than the transmitting wave
C) Same as that of the transmitting wave
D) Either smaller or larger than the transmitting wave

Q.43 **Stars moving towards earth shows**
A) blue shift
B) no shift
C) red shift
D) may be 'A' may be 'B' depending upon speed of stars

Q.44 **Bats navigate and find food by**
A) ultrasonic
B) [illegible]
C) echo location
D) refraction

Q.45 **Which one of the following explains that all the galaxies are receding from us?**
A) White shift
B) [illegible] stars
C) Black holes
D) Red shift

Q.46 **A whistle giving out 450Hz approaches a stationary observer at a speed of 33m/s. The frequency heard by the observer in Hz is (speed of sound = 330m/s).**
A) 409
B) [illegible]
C) 517
D) 500

Q.47 [illegible] of a frequency of 3 kHz reaches an observer with [illegible] the velocity of sound in air. The frequency heard by the observer [illegible]

A) 1 kHz
B) 3 kHz
C) 4 kHz
D) 6 kHz

Q.48 A whistle producing sound waves of frequencies 9500 Hz and it is approaching [illegible] stationary person with speed v ms^{-1}. The velocity of sound in air is 300 ms^{-1}. [illegible] person can hear frequencies upto a maximum of 10,000 Hz, the maximum [illegible] upto which he can hear the whistle is

A) [illegible]
B) [illegible]
C) [illegible]
D) [illegible]

ELECTROMAGNETIC SPECTRUM

Q.49 Which of following has higher momentum

A) Radio waves
B) [illegible] rays
C) X-rays
D) Red light

Q.50 Choose the correct order with respect to energy

A) $E_{uv} > E_{x-rays} > E_{\gamma-rays}$
B) $E_{uv} = E_{x-rays} = E_{\gamma-rays}$
C) $E_{uv} < E_{x-rays} < E_{\gamma-rays}$
D) $E_{x-rays} > E_{uv} > E_{\gamma-rays}$

ANSWER KEY

[illegible]	A	[illegible]	D	21	A	31	C	41	B
[illegible]	A	[illegible]	B	[illegible]	D	[illegible]	C	[illegible]	B
[illegible]	D	[illegible]	A	[illegible]	B	[illegible]	B	[illegible]	A
[illegible]	D	[illegible]	C	[illegible]	C	[illegible]	A	[illegible]	C
[illegible]	A	[illegible]	C	[illegible]	C	[illegible]	C	[illegible]	D
[illegible]	B	[illegible]	C	[illegible]	B	[illegible]	D	[illegible]	D
[illegible]	D	[illegible]	B	[illegible]	A	[illegible]	B	[illegible]	D
[illegible]	A	[illegible]	C	[illegible]	B	[illegible]	D	[illegible]	B
[illegible]	A	[illegible]	D	[illegible]	C	[illegible]	C	[illegible]	C
[illegible]	C	[illegible]	B	[illegible]	A	[illegible]	C	[illegible]	C

EXPLANATORY NOTES

Q.1 The zero displacment at p will move Q in $\frac{1}{8}\lambda$ distance away. Period of wave, $T = \frac{1}{f} = \frac{1}{12.5} = 0.08$ 1 wavelength takes 0.08s. $\frac{1}{8}$ wavelength takes $\frac{1}{8}(0.08) = 0.01$.

Q.2 Distance between two consecutive crests = λ.

Distance between consecutive crests and trough = $\frac{\lambda}{2}$

Q.3 $v = f\lambda \Rightarrow f = \frac{v}{\lambda} = \frac{130}{5} = 26\text{Hz}$

Q.4 Maximum displacement from mean position

Q.5 Speed $= \frac{\text{distance}}{\text{time}}$

$= \frac{1020}{3} = 340\,\text{m s}^{-1}$

Q.6 Frequency does not depend upon nature of material.

Q.7 Longitudinal waves involve changes in the volume and density of the medium. Since all media can sustain compressive stress, longitudinal waves can be transmitted through all the three types of media

Q.8 $\Delta\varphi = 60° = \pi/3$

$\Delta x = \lambda/2\pi \times \Delta\varphi = \lambda/2\pi \times \pi/3 = \lambda/6$

Q.9 For beats formation, frequency of sources should be slightly different and amplitude should be the same.

Q.10 Third over tone mean fourth harmonic $f_4 = 4f_1$

Q.11 In closed organ pipe 2nd over tone mean fifth harmonic

$f_5 = 5f_1 = 5 \times 50 = 250\text{Hz}$

Q.12 $f = \frac{v}{2\ell}$, $v \propto \sqrt{T}$

Q.13 $[f_1]_{closed} = \frac{1}{2}[f_1]_{open}$

Q.14 [illegible]

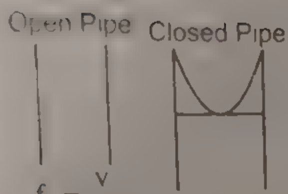
[illegible] motion of particle of the medium [illegible]

[illegible] past these point

Q.16 [illegible] m

Q.17 [illegible] n

Q.18



$f_1 = \dfrac{v}{2l}$

Here, $\ell' = \dfrac{\ell}{2}$

Now it is closed end pipe

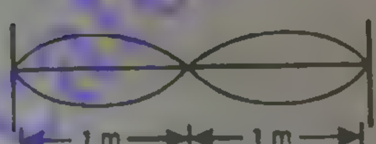
$$f' = \frac{v}{4\ell'} = \frac{v}{4\frac{\ell}{2}} = \frac{v}{2\ell} = f_1$$

Q.19 $f' = f_2 - f_1$

Q.20 $\lambda_n = \dfrac{2\ell}{n}$

$\lambda_n \propto \dfrac{1}{n}$

Q.21



$\dfrac{\lambda}{2} = 1$

$\lambda = 2$ metre

Distance between nearest node and antinode is

$$\frac{\lambda}{4} = \frac{2}{4} = 0.5\,m = 50\,cm$$

Q.22 Phase difference between two in phase points is $\lambda, 2\lambda, 3\lambda$...

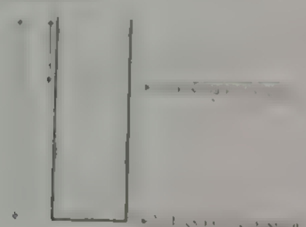
Q.23 Distance between two consecutive antinodes is $\frac{\lambda}{2} = x$ and phase differen $= \frac{2\pi x}{\lambda} = \frac{2\pi}{\lambda} \cdot \frac{\lambda}{2} = \pi$

Q.24

Q.25

Q.26 For a closed end organ pipe, only odd harmonics are produced (i.e. f, 3f, 5f ...) so in closed end organ pipe the 1st overtone is 3f and 2nd overtone is 5f and so on

Q.27 From figure, the length of 2nd resonance position is 3 times of the length of 1st resonance position



Q.28 $f \propto \frac{1}{\lambda}$

Q.29 In closed pipe, only odd harmonics are present.

Q.30 $f = \frac{1}{2l}\sqrt{\frac{T}{m}}$ where $m = \frac{\rho V}{l} = \frac{\rho(Al)}{l} = \rho A$

So $f \propto \frac{1}{\sqrt{A}}$ and $f' \propto \frac{1}{\sqrt{\frac{A}{4}}} \Rightarrow \frac{f'}{f} = 2$ OR $f' = 2f$

Q.31 At extreme point energy stored is P.E.

Q.32 Open pipe is richer in harmonics because both odd and even harmonics are present in open pipe.

Q.33 $v = (300)(3) = 900\,\mathrm{m\,s^{-1}}$

Q.34 Fundamental frequency of a closed pipe, f = v/4L = 512Hz

Fundamental frequency of open pipe

$2 \times 512 = 1024\,\mathrm{Hz}$

Q.35

Q.36 Doppler's effect is applicable on light and sound waves.

Q.37 ...

From formula Doppler shift in frequency does not depend upon distance of the source and listener

Q.38 As source is moving towards stationary observe.

$f' = \frac{v}{v - v_s} f \Rightarrow f' > f$ so pitch will increase.

Q.39 $f = \frac{54}{60} = 0.9\,\text{Hz}$

$v = f\lambda = (0.9)(10) = 9\,\text{ms}^{-1}$

Q.40 $\frac{f'}{f''} = \frac{v + u}{v - u} = \frac{352 + u}{352 - u} = \frac{6}{5}$

Q.41 $f_1 = \left(\frac{v}{v - u_s}\right) f$

$f_A = \left(\frac{v}{v - \frac{v}{3}}\right) 100 \Rightarrow f_A = \frac{3}{2} \times 100 = 150\,\text{Hz}$

Q.42 Source is moving away from observer so apparent frequency decreases and wavelength increases.

Q.43 When star is moving towards earth, according to Doppler's shift wavelength decreases, blue light has smaller wavelength so blue shift appears.

Q.44 Bats use echolocation to navigate and find food in the dark. To echolocate, bats send sound waves from their mouth or nose. When sound waves hit an object they produce echo. Bats use this, to avoid flying into objects.

Q.45 When galaxies or stars are receding from us its emitted light wavelength increases, colour of spectrum is red.

Q.46 $v' = v/(v - v_s) \times v$

$v' = 330/(330 - 33) \times 450 = 500\,\text{Hz}$

Q.47 $f' = (v/(v - v_s)) \times f = v/(v - 0.5v) \times 3\text{kHz} = 6\text{kHz}$

Q.48 $f_1 = \left(\frac{v}{v - u_s}\right) f$

$10{,}000 = \left(\frac{300}{300 - v}\right) 9500 \Rightarrow v = 15\,\text{ms}^{-1}$

Q.49 $E = Pc \Rightarrow E \propto P$

Q.50 $E = hf$

$E \propto f$

So $f_{x\text{-rays}} > f_{\ldots} > f_{\ldots}$

$E_{\ldots} > E_{\ldots} > E_{\ldots}$

PAST PAPER MCQ's (2008-2019)

2008

Q. 1 A standing wave pattern is formed when the length of string is an integral multiple of ________ wavelength.

A) Triple
B) Full
C) Half
D) Double

Q. 2 Two waves of slightly different frequencies and traveling in same direction produce ________

A) Interference
B) Polarization
C) Stationary waves
D) Beats

Q. 3 A 2m long pipe is open at both ends. What is its harmonic frequency?

A) 42.5 Hz.
B) 85 Hz

Q. 4 Transverse waves cannot be setup in ________

A) Metals
B) Solids
C) Fluids
D) Soil

2009

Q. 5 Speed of the waves is equal to:

A) fλ
B) T
C) Both A and B
D) λT

Q. 6 Two waves of slightly different frequencies and travelling in the same direction lead to:

A) Stationary Waves
B) Interference
C) Beats
D) Both B and C

Q. 7 What is it that we use to calculate the speeds of distant stars and galaxies?

A) Doppler Effect
B) Interference
C) Beats
D) All of the above

Q. 8 Speed of light, radio waves and microwaves in vacuum is:

A) 3×10^5 ms^{-1}
B) 3×10^7 ms
C) 3×10^6 ms^{-1}
D) 3×10^8 ms

2010

Q. 9 An organ pipe closed at one end has a length of 25 cm. Wavelength of the fundamental note is

A) 25 cm
B) 50 cm
C) 100 cm
D) 75 cm

Q. 10 Two waves of same amplitude are traveling in the same direction and are out of phase, their resultant wave is:

A) Zero
B) Equal to difference of their amplitudes
C) Equal to sum of their amplitudes
D) Equal to half of their amplitude

Q. 11 A source 'Y' of unknown frequency produces 4 beats with a source of 240 Hz and 8 beats with a sound of 252 Hz. Frequency of the source 'Y' is

A) 244 Hz
B) 236 Hz
C) 248 Hz
D) 246 Hz

2011

Q. 12 The spectrum of a star's light is measured and the wavelength of one of the ... the sodium's line is found to be 589 nm. The same line has the wavelength of ... when observed in the laboratory. This means the star is

A) Moving away from the earth
B) Moving towards the north
C) Stationary
D) Revolving around the planet

2012

Q. 13 **When the source of sound moves towards the stationary observer, the value of apparent frequency 'f_o' is:**

A) $f_o = \left(\frac{v+u}{v}\right)f$
B) $f_o = \left(\frac{v}{v-u}\right)f$
C) $f_o = \left(\frac{v}{v+u_2}\right)f$
D) $f_o = \left(\frac{v-u}{v}\right)f$

2015

Q. 14 **An observer moves with velocity 'v_o' toward a stationary source, then the number of waves received in one second is**

A) $f' = f\left(\frac{v}{v+u_s}\right)$
B) [illegible]
C) $f' = f\left(\frac{v+u_o}{v}\right)$
D) $f' = f\left(\frac{v-u_o}{v}\right)$

2016

Q. 15 The red shift measurement of Doppler effect of galaxies indicate that the universe is

A) Expanding
B) Contracting
C) Stationary
D) Oscillating

2017

Q. 16 If a wave travelling at a speed of 130 m/s and has a wavelength of 5m. Then find frequency of the wave?

A) 650 Hz
B) 20 Hz
C) 3.8×10^2 Hz
D) 26 Hz

Q. 17 A metallic wire of 2m length hooked between two points has tension of 10N. If mass per unit length of wire is 0.004 kg/s then fundamental frequency emitted by vibration is:

A) 12.5 Hz
B) 48 Hz
C) 24 Hz
D) 6.25 Hz

Retake Test 2017

Q. 18 A source of sound moves towards a stationary observe with speed one third ... the frequency of the sound from the source is 100 Hz, the apparent frequency of sound heard by the observer is:

A) 60 Hz
B) 100 Hz
C) 200 Hz
D) 150 Hz

2018

Q. 19 A shock wave is produced due to an earthquake which makes the building move in the direction of the shock wave. Which progressive wave would this be?

A) Longitudinal wave
B) Transverse wave
C) Material wave
D) Particle wave

2019

Q. 20 The wavelength of the electromagnetic wave having frequency of 3 kHz will be?

A) 80 km
B) 110 km
C) 100 km
D) 120 km

Q. 21 What will be the expression for the observed frequency, if the source is moving towards the observer?

A) $f_o = \left(\frac{v}{v-u_s}\right)f$

B) $f_o = \left(\frac{v}{v+u_s}\right)f$

C) $f_o = \left(\frac{v}{v \pm u_s}\right)f$

D) $f_o = \left(\frac{v}{v-u}\right)f$

ANSWER KEY

1	C	11	A	21	A
2	D	12	A		
3	B	13	B		
4	C	14	C		
5	C	15	A		
6	C	16	D		
7	A	17	A		
8	D	18	D		
9	C	19	A		
10	A	20	C		

EXPLANATORY NOTES

Q.1 [illegible] is formed when length of string is an [illegible]

Q.2 Definition of Beats

Q.3 $f = \frac{v}{2l} = \frac{340}{2\times 2} = 85Hz$

Q.4 [illegible] because they required [illegible]

Q.5 [illegible]

Q.6 Definition of Beats.

Q.7 [illegible] speed of distant stars and galaxies

Q.8 [illegible] waves in vacuum travels with speed of light [illegible]

Q.9

$= 4\frac{(25)}{100} = 1m = 100cm$

Q.10 [illegible] phase superpose at same amplitude the resultant [illegible]

Q.11

Q.12 [illegible]

[illegible] star is moving away from earth

Q.13 [illegible] moves towards stationary observer $f' = \left(\frac{v}{v-u}\right)f$

Q.14 [illegible] moves toward stationary observer $f' = \left(\frac{[illegible]}{v}\right)f$

Q.15 [illegible] universe is expanding

Q.16 [illegible]

Q.17 [illegible]

Q. 19 Definition of longitudinal waves

Q. 20 $= 100km$

Q. 21

PRACTICE EXERCISE

TOPIC-WISE MCQ's

INTERFERENCE OF LIGHT WAVES, CONSTRUCTIVE AND DESTRUCTIVE INTERFERENCE

Q.1 Huygen's conception of secondary waves

A) Allow us to find the focal length of a thick lens

B) Is a geometrical method to find a wavefront

C) Is used to determine the velocity of light

D) Is used to explain polarization

Q.2 Two coherent sources of light can be obtained by

A) Two different lamps

B) Two different lamps but of the same power

C) Two different lamps of same power and having the same colour

D) None of the above

Q.3 By a monochromatic wave, we mean

A) A single ray

B) SA single ray of a single colour

C) Wave having a single wavelength

D) Many rays of a single colour

Q.4 Two identical light sources S_1 and S_2 emit light of same wavelength λ. These light rays will exhibit interference if

A) Their phase differences remain constant

B) Their phases are distributed randomly

C) Their light intensities remain constant

D) Their light intensities change randomly

Q.5 Two light sources are said to be coherent if they are obtained from

A) Two independent point sources emitting light of the same wavelength

B) Single point source

C) A wide source

D) Two ordinary bulbs emitting light of different wavelengths

Q.6 Two sources of light are coherent if they emit rays of

A) Same wavelength

B) Same amplitude of vibration

C) Same wavelength with constant phase difference

D) Same amplitude and wavelength

YOUNG'S DOUBLE SLIT EXPERIMENT, FRINGE SPACING, DARK AND BRIGHT FRINGES

Q.7 In Young's double slit experiment, if the slit widths are in the ratio 1 : 9, then the ratio of the intensity at minima to that at maxima will be

A) 1

B) 1/4

C) 1/9

D) 1/3

Q.8 In Young's double slit experiment with a source of light of wavelength 6320A, the first maxima will occur when

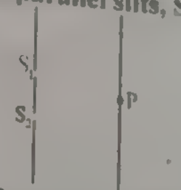
A) Path difference is 9480 A

B) Phase difference is 2π radian

C) Path difference is 6320 A

D) Both 'B' and 'C'

Q.9 Coherent light incident on two fine parallel slits, S_1 and S_2 as shown the diagram



If a dark fringe occurs at P, which of the following gives possible phase differences for the light wave arriving at P from S_1 and S_2?

A) $2\pi, 4\pi, 6\pi$......

B) $\pi, 2\pi, 3\pi$....

C) $\pi, 3\pi, 5\pi$......

D) $\frac{1}{2}\pi, \frac{5}{2}\pi, \frac{9}{2}\pi$......

Q.10 Condition for constructive interference of two coherent beams is that the path difference should be

A) Integral multiple of $\frac{\lambda}{2}$

B) Odd integral multiple of $\frac{\lambda}{2}$

C) Integral multiple of λ

D) Even integral multiple of λ

Q.11 When the light from two lamps falls on a screen, no interference pattern can be obtain. Why is this?

A) The lamps are not point source

B) The lamps emit light of different amplitude

C) The light from the lamp is not coherent

D) The light from the lamp is white

Q.12 As a result of interference of two coherent sources of light, energy is

A) Redistributed and distribution does not vary with time

B) Increased

C) Decrease

D) Redistributed and distribution changes with time

Q.13 Monochromatic light illuminates two narrow parallel slits. The interference pattern which results is observed on a screen some distance beyond the slits. Which change increases the separation between the dark lines of the interference pattern?

A) decreasing the distance between the screen and the slits

B) decreasing the distance between the slits

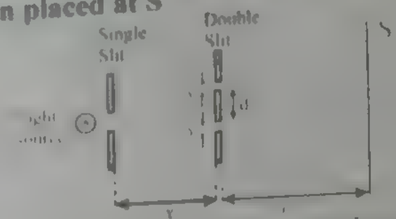
C) using monochromatic light of higher frequency

D) using monochromatic light of longer wavelength

Q.14 Under which of the following sets of condition will the separation of the bright fringes of double slit interference pattern be greatest?

	Distance between slits	Distance from slit to screen	Wavelength of source
A)	Small	Small	Short
B)	Small	Large	Short
C)	[illegible]	Large	Long
D)	Large	Small	Short

Q.15 In the young slit arrangement shown in the figure, a pattern of equally spaced, parallel fringes appear on a screen placed at S



Which quantity, if increase, would cause the separation of fringes to increase?

A) x
B) d
C) y
D) l

Q.16 **Position of dark fringes in Young's double-slit experiment are given by**

A) $Y_m = m\lambda \frac{L}{d}$
B) $Y_m = \left(m+\frac{1}{2}\right)\lambda \frac{L}{d}$
C) $Y_m = m\lambda \frac{d}{L}$
D) $Y_m = 2m\lambda \frac{L}{d}$

Q.17 **In young's double slit experiment, the fringe width depends on**

A) Wavelength of the light used
B) Distance between the slits
C) Distance between the slits and screen
D) All of them

Q.18 **For which of the following colours will the fringe-width be minimum in the double-slit experiment:**

A) Violet
B) Green
C) Red
D) Yellow

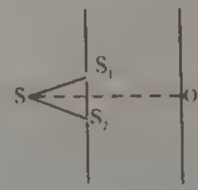
Q.19 **The distance between two adjacent bright fringes, Δy is**

A) $\frac{2\lambda L}{d}$
B) $\frac{\lambda L}{2d}$
C) $\frac{3\lambda L}{d}$
D) $\frac{\lambda L}{d}$

Q.20 **In Young's double slit experiment, the band width of fringe is independent of**

A) distance between the coherent sources
B) distance of the screen from the sources
C) wavelength of light emitted by the sources
D) order of the fringe

Q.21 **In set up shown in the figure, the two slits S_1 and S_2 are equidistance from the slit S. The central fringe at O is then**



A) always bright
B) always dark
C) either dark or bright depending on the position of S
D) neither dark not bright

Q.22 **In a Young's double-slit experiment, the slit separation is doubled. To maintain the same fringe spacing on the screen, the screen-to-slit distance L must be changed to:**

A) 2L
B) [illegible]
C) $L/\sqrt{2}$
D) [illegible]

Q.23 What is the path difference between PA and PB on the screen ('B' and 'D' represents dark and bright fringes)?

A) $\frac{\lambda}{2}$

B) $\frac{3\lambda}{2}$

C) λ

D) 2λ

Q.24 Light from a small region of an ordinary incandescent bulb is passed through a yellow filter and then serves as the source for a Young's double-slit experiment. Which of the following changes would cause the interference pattern to be more closely spaced?

A) Use slits that are closer together

B) Use a light source of lower intensity

C) Use a blue filter instead of a yellow filter

D) Use a light source of higher intensity

Q.25 In Young's double slit experiment, the condition for bright fringe is expressed as

A) $d\sin\theta = \left(m - \frac{1}{2}\right)\lambda$

B) $2d\sin\theta = m\lambda$

C) $d\sin\theta = \left(m + \frac{1}{2}\right)\lambda$

D) $d\sin\theta = m\lambda$

Q.26 If the source of light used in a Young's double slit experiment is changed from red to violet,

A) the fringes will become brighter

B) consecutive fringes will come closer

C) the intensity of minima will increase

D) the central bright fringe will become a dark fringe

Q.27 In Young's double slit interference experiment, if the slits separation is made 3 folds, the fringe width becomes

A) 6 fold

B) 3 fold

C) 3/6 fold

D) 1/3 fold

Q.28 In Young's experiment, the ratio of maximum to minimum intensities of the fringe system is 4 : 1. The amplitude of the coherent sources are in the ratio

A) 4 : 1

B) 3 : 1

C) 2 : 1

D) 1 : 1

Q.29 If YDSE arrangement is shifted in water, then first maxima will be formed at ______ angle as compared to one formed in air

A) Greater

B) Smaller

C) Same

D) Static pattern will not be formed

Q.30 Maxima is termed as

A) bright fringe

B) white light

C) monochromatic light

D) dark fringe

Q.31 To observe diffraction, the size of an obstacle

A) should be of the same order as wavelength

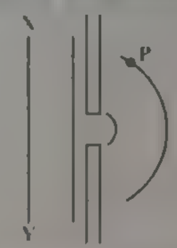
B) should be much larger than the wavelength

C) has no relation to wavelength

Q.32 In an interference pattern
A) Bright fringes are wider than dark fringes
B) Dark fringes are wider than bright fringe
C) Both dark and bright fringes are of equal width
D) Central fringes are dimmer than the outer fringes

Q.33 Which of following is conserved when light waves interfere?
A) Intensity
B) Energy
C) Amplitude
D) Momentum

Q.34 A monochromatic plane wave of speed 'c' and wavelength λ is diffracted at a small aperture.



The time during which a portion of the wavefront XY reaches at 'P' will be
A) $\frac{3\lambda}{2c}$
B) $\frac{2\lambda}{c}$
C) $\frac{3\lambda}{c}$
D) $\frac{4\lambda}{c}$

Q.35 In which situation does diffraction occur?
A) A wave bounces back from a surface
B) A wave passes from one medium into another
C) A wave passes through an aperture
D) Waves from two identical sources are superposed

DIFFRACTION (BASIC PRINCIPLE)

Q.36 Diffraction is a characteristic of
A) particle
B) both A and C
C) wave
D) none of these

Q.37 Diffraction effects are
A) more for sharp edges
B) less for round edge
C) less for cylindrical
D) less for sharp edge

Q.38 In diffraction the phenomenon is found to be prominent when the wavelength of light is large as compared with the
A) aperture of the slit
B) number of the slits
C) size of the slit
D) all of these

Q.39 When the light passes through the pinhole opening, then the spreading of light is due
A) interference
B) polarization
C) diffraction
D) scattering

Q.40 Interference and diffraction of light support the:
A) Electromagnetic nature of light
B) Quantum nature of light
C) Wave nature of light
D) Longitudinal nature of light waves

Q.41 The relation of grating element can be expressed as:

A) $\dfrac{\text{Length of grating element}}{\text{Distance between the slits}}$

B) $\dfrac{\text{Number of lines ruled on it}}{\text{Length of grating element}}$

C) $\dfrac{\text{Length of the grating element}}{\text{Number of lines ruled on it}}$

D) $\dfrac{\text{Distance between the slits}}{\text{Length of grating element}}$

Q.42 Two monochromatic radiations X and Y are incident normally on a diffraction grating. The second order intensity maximum for X coinsides with the third order intensity maximum for Y. What is the ratio $\dfrac{\text{wavelenght of X}}{\text{wavelenght of Y}}$?

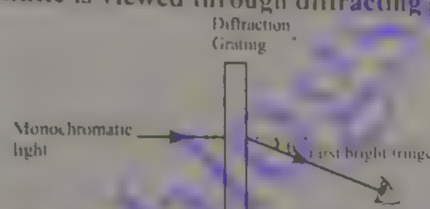
A) $\dfrac{1}{2}$

B) $\dfrac{3}{2}$

C) $\dfrac{2}{3}$

D) $\dfrac{2}{1}$

Q.43 A source of monochromatic is viewed through diffracting grating



Which of the following causes the angle θ to increase?

A) Decreasing the distance between adjacent slits on the grating

B) Decreasing the wavelength of the monochromatic light

C) Increasing the distance of eye from grating

D) Increasing the number of slits of the grating but keeping the slits spacing the same

Q.44 A diffraction grating has 500 lines per mm, its grating element d is equal to

A) 2×10^{-6} meter

B) 2×10^{-3} meter

C) 2×10^{-3} cm

D) 2×10^{-6} cm

Q.45 A parallel beam of white light is incident normally on a diffraction grating. It is noted that the second order and third order spectra practically overlap. Which have wave length in 3rd order spectrum appears at the same angle as the wavelength of 600 nm in the second order spectrum

A) 300 nm

B) 400 nm

C) 600 nm

D) 900 nm

Q.46 Unit of grating element?

A) cm^{-1}

B) m

C) m

D) no unit

Q.47 When monochromatic light of wavelength 5.0×10^{-7} m is incident normally on a plane diffraction grating, the second-order diffraction lines are formed at angle of 30° to the normal to the grating.

What is the number of lines per millimeter of the grating?

A) 250

B) 500

C) 1000

D) 4000

Q.48 A narrow beam of monochromatic light is incident normally on a diffraction grating. Third-order diffracted beams are formed at angles of 45° to the original beam. What is the highest order of diffracted beam produced by this grating?

A) 3rd
B) 4th
C) 5th
D) 6th

Q.49 A diffraction grating has N lines per unit length and is placed at 90° to monochromatic light of wavelength λ. What is the expression for θ, the angle to the normal to the grating at which the third order diffraction peak is observed?

A) $\sin\theta = \frac{1}{3N\lambda}$
B) $\sin\theta = 3N\lambda$
C) $\sin\theta = \frac{N\lambda}{3}$
D) $\sin\theta = \frac{3\lambda}{N}$

Q.50 In diffraction grating, the path difference for the constructive interference should be

A) $\frac{\lambda}{2}$
B) λ
C) $\frac{\lambda}{4}$
D) $\frac{\lambda}{8}$

ANSWER KEY

1	B	11	C	21	A	31	A	41	C
2	D	12	A	22	A	32	C	42	B
3	C	13	D	23	D	33	B	43	A
4	A	14	C	24	C	34	C	44	A
5	B	15	D	25	D	35	C	45	B
6	C	16	B	26	B	36	C	46	C
7	B	17	D	27	D	37	A	47	B
8	D	18	A	28	B	38	A	48	B
9	C	19	D	29	B	39	C	49	B
10	C	20	D	30	A	40	C	50	B

EXPLANATORY NOTES

Q.1 Huygen's conception of secondary wavelets is a geometrical method to find a wavefront.

Q.2 Coherent source cannot be obtained from two different light sources.

Q.3 Monochromatic wave means of single wavelength not the single colour.

Q.4 For interference phase difference must be constant.

Q.5 When two sources are obtained from a single source, the wavefront is divided into two parts These two wavefronts acts as if they emanated from two sources having a fixed phase relationship.

Q.6 Coherent sources of light produced light of same frequency and constant phase difference.

Q.7 Slit width ratio = 1 : 9

Since slit width ratio is the ratio of intensity and intensity $\propto$ (amplitude)^2

$I_1 : I_2 = 1 : 9$

$$\Rightarrow a_1^2 : a_2^2 = 1:9 \Rightarrow a_1 : a_2 = 1:3$$

$$I_{max} = (a_1 + a_2)^2,\ I_{min} = (a_1 - a_2)^2 \Rightarrow \frac{I_{min}}{I_{max}} = \frac{1}{4}$$

Q.8 (B, C) For maxima, path difference $\Delta = n\lambda$

So for $n = 1$, $\Delta = \lambda = 6320Å$

Q.9 In YDSE for dark fringes

Phase difference $= (2n-1)\pi$

$(\because n = 1, 2, 3, 4....)$

Q.10 For constructive interference

Path difference $(\Delta S) = n\lambda$

$(\because n = 0, 1, 2, 3, ...)$

Q.11 Light coming from two independent sources can't be coherent

Q.12 Energy is redistributed but remain conserved.

Q.13 $W = \frac{\lambda l}{d}$

$W \propto \lambda$

Q.14 $\Delta x = \frac{\lambda l}{d}$

Q.15 $\Delta y = \frac{\lambda l}{d} \Rightarrow \Delta y \propto l$

Q.16 $y_n = \left(n + \frac{1}{2}\right)\frac{\lambda l}{d}$

Q.17 [illegible]

Q.18 [illegible]

Q.19 [illegible]

Q.20 $\Delta y = \frac{\lambda L}{d}$

Q.21 At the centre of screen path difference between two rays is zero.

Q.22 $\Delta y = \frac{\lambda L}{d}$

Q.23 $d \sin\theta = n\lambda$

For 2nd order bright fringe $n = 2$

Q.24 $\Delta y = \lambda \frac{L}{d}$

$\Delta y \propto \lambda$

$(\lambda)_{yellow} > (\lambda)_{Blue} \Rightarrow (\Delta y)_{Blue} < (\Delta y)_{yellow}$

Q.25 Condition for bright fringes is $d\sin\theta = n\lambda$

Q.26 $\Delta y = \frac{\lambda L}{d} \Rightarrow \Delta y \propto \lambda$

Q.27 $\Delta y = \frac{\lambda L}{d} \Rightarrow \Delta y \propto \frac{1}{d}$

Q.28 $\frac{I_{max}}{I_{min}} = \frac{(a_1 + a_2)^2}{(a_1 - a_2)^2}$

$\frac{(a_1 + a_2)}{(a_1 - a_2)} = \frac{\sqrt{I_{max}}}{\sqrt{I_{min}}}$

Q.29 $\Delta Y = \frac{L\lambda}{nd}$

As 'n' for water is greater than air so ΔY decreases for water and wavelength (λ) also decreases.

According to $d \sin\theta = m\lambda$, θ will decrease.

Q.30 Maximum is termed as bright.

Q.31 Condition for diffraction

Q.32 In interference pattern Δy is of same width for bright and dark fringes. $\Delta y = \frac{\lambda L}{d}$

Q.33 Energy is redistributed but remain conserved.

Q.34 $s = ct$

$t = \frac{\lambda}{c}$

Since there are three waves till point P

So, $t = \frac{3\lambda}{c}$

Q.35 Diffraction occurs when a wave bends around the corners of obstacle

Q.36 [illegible] characteristic of wave

Q.37 [illegible] effects are more for sharp edges.

Q.38 In diffraction wavelength of light is large as compared with the aperture of the slit

Q.39 Bending of light around an obstacle is called diffraction.

Q.40 Experiments shows wave nature of light.

Q.41 $d = \frac{L}{N}$

Q.42 $d\sin\theta = n\lambda$

$\frac{\lambda_1}{\lambda_2} = \frac{n_2}{n_1}$

Q.43 $\sin\theta = \frac{n\lambda}{d}$

Q.44 $d = \frac{L}{N} = \frac{10^{-3}}{500} = 2\times10^{-6}\text{m}$

Q.45 $d\sin\theta = n\lambda$

$\frac{\lambda_1}{\lambda_2} = \frac{n_2}{n_1}$

Q.46 $d = \frac{L}{N}$

Q.47 $d\sin\theta = n\lambda$

$d = \frac{L}{N}$

Q.48 $d\sin\theta = n\lambda$

$\frac{\sin\theta_1}{\sin\theta_2} = \frac{n_1}{n_2}$

Q.49 $d\sin\theta = n\lambda$

$\frac{L}{N}\sin\theta = 3\lambda$

$\frac{L}{N}\sin\theta = 3\lambda$

$\sin\theta = 3\lambda N$

Q.50 Path difference $(\Delta S) = n\lambda$

$n = 1, 2, 3, 4$

PAST PAPER MCQ's (2008-2019)

Q. 1 In Young's Double Slit Experiment, if the distance between slits and screen is double then fringe spacing becomes:

A) Zero
B) One
C) Doubles of the original value
D) Half of the original value

2010

Q. 2 The path difference 'BD' for destructive interference is

A) $(m + \frac{1}{2})\lambda$
B) $m\lambda$
C) $d \sin \theta$
D) 3λ

2011

Q. 3 For interference of light waves to take place, the required condition is

A) The path difference of the light waves from the two sources must be large
B) The interfering waves must be non-coherent
C) The light waves may come from different sources
D) The light waves must come from two coherent sources

Q. 4 The property of bending of light around an obstacle and spreading of light waves in geometric shadow of an obstacle is called:

A) Diffraction of Light
B) Polarization of Light
C) Quantization of Light
D) Interference of Light

2013

Q. 5 In the diffraction of light round an obstacle, the angle of diffraction is increased when

A) The wavelength of incident light wave is decreased
B) The amplitude of the incident light wave is increased
C) The wavelength of incident light wave is increased
D) The amplitude of the incident light wave is decreased

2014

Q. 6 An oil film floating on water surface exhibits colour pattern due to the phenomenon of

A) Diffraction
B) Polarization
C) Interference
D) Surface tension

2015

Q. 7 The distance between two bright or two dark adjacent fringes is mathematically written as:

A) $\Delta Y = \frac{\lambda L}{d}$
B) $\Delta Y = \frac{\lambda}{dL}$
C) $\Delta Y = \frac{\lambda d}{L}$
D) $\Delta Y = \frac{d}{\lambda L}$

Q. 8 In Young's Double slit experiment, slit separation a = 0.05 cm, distance between screen and slit D = 200 cm, fringes separation x = 0.13 cm, then the wavelength 'λ' of light is:

A) $\lambda = 1.33 \times 10^{-2}$ m
B) $\lambda = 3.25 \times 10^{-7}$ m
C) $\lambda = 4.55 \times 10^{-3}$ m
D) $\lambda = 5.1 \times 10^{-5}$ m

Q. 9 If general equation for destructive interference's is given by the relation Optic path difference $= \left(m + \frac{1}{2}\right)\lambda$ Where 'm' is an integer, then first dark fringe appear for 'm' will be equal to:

A) $\frac{2}{3}$

B) $\frac{1}{2}$

C) 0

D) 1

Q. 10 For bright fringe formation the path difference is

A) $\left(n+\frac{1}{2}\right)\lambda$ where n = 0,1,2.........

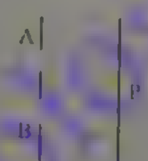
B) $n\lambda$ where n = 0,1,2.........

C) $(2n+1)\frac{\lambda}{2}$ where n = 0,1,2.........

D) $\left(\frac{n+1}{2}\right)\lambda^2$ where n = 0,1,2.........

2017

Q. 11 Coherent light emerge from two fine parallel slit 'A' and 'B' as shown in the figure below:



If 'p' is the position of 'nth dark fringe from the centre of interference pattern then the phase difference between the wave train from 'A' and 'B' is:

A) $n\pi$ radian

B) $(2n+1)\pi$ radian

C) $2n\pi$ radian

D) $\left(n+\frac{1}{2}\right)\pi$ radian

Q. 12 Wavelength of light which produces second order spectrum on a diffraction grating on which 5000 lines/cm are ruled at an angle of 30° will be equal to:

A) $6 \times 10^{[illegible]}$ m

B) $4 \times 10^{[illegible]}$ m

C) 3×10^{-6} m

D) 5×10^{-7} m

Retake 2017

Q. 13 In YDSE if we use white light in place of a monochromatic light, then:

A) Centre will be bright and red color will be close to it

B) Centre will be bright and blue color will be closer to it

C) Centre will be dark and red color will be closer to it

D) Centre will be dark and blue color will be closer to it

2018

Q. 14 A diffraction grating contains 5000 lines per centimeter, its grating element will be

A) [illegible] $\times 10^{[illegible]}$ mm

B) [illegible] $\times 10^{[illegible]}$ cm

C) 2×10^{-14} m

D) $2 \times 10^{[illegible]}$ m

2018

Q. 15 Path difference for the destructive interference can be written as

A) $\Delta s = n\lambda$

B) $\Delta s = (n + 1/3)\lambda / 2$

C) $\Delta s = 2n(\lambda)$

D) $\Delta s = (2n + 1)\lambda / 2$

Q. 16 If a light is emitted by a single source passes through two narrow slits 1.00 mm apart. The interference pattern is observed on a screen 200 cm away and the separation between the centres of adjacent bright fringes is 2.00 mm. What would be the wavelength of the light?

A) 2µm

B) 1 µm

C) 2 pm

D) 1 nm

Q. 17 In double slit experiment, the fringe spacing of the diffracted rays increases when:

A) the distance between the screen and the slits decreases

B) the wavelength of the diffracted rays increases

C) the distance from mid points of the slits to the central point of the fringe on the screen increases

D) the distance between the slits increases

ANSWER KEY

1	C	11	B
2	A	12	D
3	D	13	A
4	A	14	D
5	C	15	D
6	C	16	B
7	A	17	B
8	B		
9	C		
10	B		

EXPLANATORY NOTES

Q. 1 $\Delta y = L\dfrac{\lambda}{d}$

$\Delta y' = 2L\dfrac{\lambda}{d}$

$\Delta y' = 2\Delta y$

Q. 2 Path difference (destructive interference) = $BD = \left(m + \dfrac{1}{2}\right)\lambda$

Q. 3 For interference of light waves to take place, light waves must come from two coherent source.

Q. 4 Definition of diffraction.

Q. 5 Diffraction occurs when $\lambda \geq d$ = size of obstacle. $d\sin\theta = n\lambda$

Q. 6 It is due to interference of light

Q. 7 $\Delta Y = \dfrac{\lambda L}{d}$ = fring spacing

Q. 8 $\Delta y = \dfrac{L\lambda}{d} \Rightarrow x = \dfrac{D\lambda}{a} \Rightarrow \lambda = \dfrac{(0.13\times10^{-2})(0.05\times10^{-2})}{200\times10^{-2}} = 3.25\times10^{-7}\,m$

Q. 9 Optical P.d $= \left(m + \dfrac{1}{2}\right)\lambda$ put $m = 0$

Q. 10 Optical P.d $= n\lambda$, $n = 0, 1, 2, 3\ldots$ for constructive interference.

Q. 11 $\phi = \dfrac{2\pi}{\lambda} \times$ P.d, here P.d $= \left(n + \dfrac{1}{2}\right)\lambda \Rightarrow \phi = \dfrac{2\pi}{\lambda}\left(n + \dfrac{1}{2}\right)\lambda = \pi(2n+1)$

Q. 12 Gritting element having 5000/cm. $\Rightarrow d = \dfrac{L}{N} = \dfrac{10^{-2}}{5000} = 2\times10^{6}$

$d\sin\theta = m\lambda \Rightarrow \lambda = \dfrac{d\sin\theta}{m} = \dfrac{(2\times10^{-6})\left(\dfrac{1}{2}\right)}{2} = 5\times10^{-7}\,m$

Q. 13 In YDSE, if we use whit, than centre will be white, although at other places coloured fringes will be obtained. At centre, path difference is zero for all wavelegth. Hence, all wavelengths will interfer constructively.

Q. 14 $d = \dfrac{L}{N} = \dfrac{1\times10^{-2}}{5000} = 0.2\times10^{-5} = 2\times10^{-6}\,m$

Q. 15 $\Delta s = (2n+1)\lambda/2$ for destructive interference.

Q. 16 $\Delta y = \dfrac{L\lambda}{d} \Rightarrow \lambda = \dfrac{\Delta y d}{L} = \dfrac{(2\times10^{-3})(1\times10^{-3})}{200\times10^{-2}} = 1\mu m$

Q. 17 $\Delta y = \dfrac{L\lambda}{d} \Rightarrow \Delta y \propto \lambda$

TOPIC-8 HEAT AND THERMODYNAMICS

PRACTICE EXERCISE

TOPIC-WISE MCQ's

BASIC POSTULATES OF KINETIC THEORY OF GASES

Q.1 Which of the following is not an assumption of Kinetic theory?
A) Finite volume of gas consists of very large number of molecules
B) The gas molecules are in random motion
C) Collision between the gas molecules are inelastic
D) Diameter of the gas molecules is much smaller than the separation between molecules

PRESSURE EXERTED BY A GAS AND DERIVE THE RELATION $PV = \frac{Nm}{3}\langle v^2\rangle$

$PV = \frac{Nm}{3}\langle v^2\rangle$ and PV = NkT AND PROVE THAT K.E ∝ T FOR A SINGLE MOLECULE

Q.2 The temperature of a gas at pressure P and volume V is 27°C. Keeping its volume constant if its temperature is raised to 927°C, then its pressure will be
A) 2 P
C) 3 P
B) 4 P
D) 6 P

Q.3 4 moles of an ideal gas is at 0°C. At constant pressure it is heated to double its volume then its final temperature will be
A) 0°C
C) 273°C
B) 546°C
D) 136.5°C

Q.4 If the average K.E of gas molecules become twice then the pressure would become
A) half
C) twice
B) quadrupled
D) remain same

Q.5 Pressure of a gas is:
A) Proportional to the average K.E
C) Proportional to the absolute temperature
B) Both "A" and "C"
D) Proportional to the volume only

Q.6 The K.E of the molecular motion appears as
A) P.E
C) Heat
B) Temperature
D) With P.E or heat

Q.7 At constant volume temperature is increases, then
A) Collisions on walls will be less
B) Number of collisions per unit time will increase
C) Collisions will be in straight line
D) Collisions will not change

Q.8 When we heat a gas sample from 27°C to 327°C, then the initial average kinetic energy of the molecules was E. What will b the average kinetic energy?

Q.9 The kinetic Theory of gases breaks down most at

Q.10 Four gas molecules have the speeds shown

Speed/10^2 m s^{-1}	1.0	3.0	5.0	7.0

What is their root means square speed?

A) 2.0×10^2 m s^{-1}
B) 4.0×10^2 m s^{-1}
C) 2.3×10^2 m s^{-1}
D) 4.6×10^2 m s^{-1}

Q.11 The collisions among the gas molecules and with the walls of container are assumed to be

A) perfectly elastic
B) inelastic
C) elastic
D) None of them

Q.12 The average translational K.E. per molecule of an ideal gas in terms of pressure is given by:

A) $\frac{3P}{2N_A}$
B) $\frac{3N_A}{2P}$
C) $\frac{2P}{3N_A}$
D) $\frac{2N_A}{3P}$

Q.13 In a vessel, the gas at a pressure P. If the mass of all molecules is halved and their speed is doubled, then the resultant pressure will be

A) 4P
B) 2P
C) P
D) P/2

Q.14 The pressure of a gas is equal to:

A) $\frac{2}{3}$ of the translational K.E. of the molecules in a unit volume
B) Translational K.E. of the molecules in a unit volume
C) $\frac{1}{3}$ of the translational K.E. of the molecules in a unit volume
D) $\frac{1}{2}$ of the translational K.E. of the molecules in a unit volume

Q.15 The pressure exerted on the walls of the container by a gas is due to the fact that the gas molecules

A) Lose their kinetic energy
B) Stick to the walls
C) Are accelerated towards the walls
D) Change their momenta due to collision with the walls

Q.16 A surface is bombarded by particles, each of mass small 'm', which have velocity 'v' normal to the surface. On average, n particles strike unit area of the surface each second and rebound elastically. What is the pressure on the surface?

A) nmv
B) [illegible]
C) $\frac{1}{2}$ nmv^2
D) nmv^2

Q.17 The pressure of gas everywhere inside the vessel will be the same provided the gas is of

A) Non uniform density
B) High density
C) Uniform density
D) Low density

Q.18 Which of the following is a postulate of kinetic theory of gases:

A) A finite volume of a gas consists of a small number of molecules.
B) [illegible] the molecules is much larger than the separating between them
C) [illegible] force on each other except during a collision
D) The gas molecules are in no random motion

Q.19 On which factor does the average kinetic energy of gas molecules depend?

A) Nature of the gas
B) Temperature
C) Volume
D) Mass

Q.20 A bulb contains one mole of hydrogen mixed with one mole of oxygen at temperature. The ratio of rms values of velocity of hydrogen molecules to that of oxygen molecules

A) 1:16
B) 1:4
C) 4:1
D) 16:1

EQUATION OF STATE FOR AN IDEAL GAS AS PV = nRT

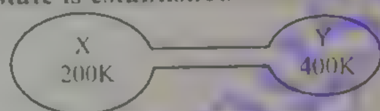
Q.21 Pressure exerted on walls of the container by the gas molecules is defined as:

A) Force per unit volume
B) Mass per unit volume
C) Force per unit area
D) Energy per unit area

Q.22 Which of the following expression is correct for molar volume V_m of an ideal gas?

A) $\frac{RT}{P}$
B) $\frac{nRT}{P}$
C) $\frac{N_A RT}{P}$
D) $\frac{NkT}{P}$

Q.23 In the diagram the volume of bulb 'X' is twice that of bulb 'Y'. The system is filled with an ideal gas and a steady state is established with the bulb held at 200 K and 400 K.



There are 'x' moles of gas in X. How many moles of gas are in Y?

A) $\frac{x}{4}$
B) x
C) $\frac{x}{2}$
D) 2x

Q.24 What does V represent in the equation $\frac{PV}{2} = RT$

A) Volume of n moles of gas
B) Mass of 2 gm of gas
C) Mass of 4 g of gas
D) Volume of 2 moles of gas

Q.25 For an ideal gas the inter particle interaction is

A) Attractive
B) Very large
C) Repulsive
D) Zero

Q.26 The ideal gas law is

A) P = nRT
B) $PV = RT^2$
C) V = nRT
D) PV = nRT

Q.27 The relation 'PV=nRT' shows which law of physics?

A) Charles' law
B) Avogadro's law
C) Newton's constant
D) Ideal gas law

Q.28 At constant pressure the graph between volume and absolute temperature

A) Parabola
B) Hyperbola
C) Straight line
D) Ellipse

Q.29 The temperature of 1kg of hydrogen gas is same as that of 1kg helium gas, if

A) gases have same internal energy
B) Gases radiate energy at the same rate
C) The gas molecules have the same root means square speed
D) The gas molecules have same mean translational K.E

Q.30 The average kinetic energy of the molecules of an ideal gas in a closed, rigid container is increased by a factor of 4. What happen to the pressure of the gas?

A) [illegible] the same
B) It increases by a factor of 4
C) It increases by a factor of 2
D) It increases by a factor of 8

Q.31 The Temperature at which the kinetic energy of a gas molecule is double its value at 27° C is

A) [illegible] C
B) 327° C
C) 300 k
D) 108° C

Q.32 In deriving the equation $p = \frac{1}{3}\rho \langle v^2 \rangle$ in the simple kinetic theory of gases, which of the following is not taken as a valid assumption?

A) Attractive forces between the molecules are negligible
B) The volume of the molecules is negligible compared with the volume of the gas
C) The molecules suffer negligible change of momentum on collision with the walls of the container
D) The duration of a collision is negligible compared with times between collisions

Q.33 The simple kinetic theory of gases may be used to derive the expression relating the pressure 'p' to the density ρ of a gas. $p = \frac{1}{3}\rho \langle v^2 \rangle$ in this expression, what does $\langle v^2 \rangle$ represents?

A) The average of the squares of the speeds of the gas molecules
B) The most probable value of the squares of the speeds of the gas molecules
C) The root means squares speed of the gas molecules
D) The square of average speed of the gas molecules

Q.34 While deriving the equation for pressure of a gas we consider the

A) Rotational motion of molecules
B) Linear motion of molecules
C) Vibrational motion of molecules
D) All of these

Q.35 The absolute temperature for the ideal gas is

A) Directly proportional to the rotational K.E. of gas molecules
B) Directly proportional to the vibrational K.E. of gas molecules
C) Directly proportional to the average translational K.E. of gas molecules
D) Sum of K.E of all molecules

Q.36 According to the Boyles law, the pressure of a gas is expressed as

A) [illegible]
B) [illegible]
C) $P \propto \frac{(\text{constant})}{V}$
D) $P \propto \frac{1}{V}$

Q.37 At absolute zero, the K.E of the molecules

A) Become minimum
B) Become zero
C) Become maximum
D) None of these

Q.38 In an ideal gas, the molecules possess

A) Only K.E
B) [illegible]
C) Only P.E
D) Only gravitational energy

…IC HEAT CAPACITY

Q.48 … C_v and $\frac{C}{C_p}$ are respectively equal to

A) $\left(\frac{1}{R}, \gamma\right)$ | C) $\left(\frac{1}{R}, \gamma\right)$
B) (R, g) | D) (R, γ^{-1})

Q.49 Calculate the work done if temperature is changes from 0°C to 200°C at one atmosphere.

A) 100 cal | C) 400 cal
B) 200 cal | D) 800 cal

Q.50 The molar specific heat constant pressure of an ideal gas is 7R/2. The ratio of specific heat at constant pressure to that at constant volume is?

A) 9/7 | C) 7/5
B) 8/7 | D) 5/7

ANSWER KEY

1	C	11	A	21	C	31	B	41	B
2	B	12	A	22	A	32	C	42	B
3	C	13	B	23	A	33	A	43	D
4	C	14	A	24	D	34	B	44	D
5	B	15	D	25	D	35	C	45	D
6	C	16	B	26	D	36	D	46	C
7	B	17	C	27	D	37	B	47	D
8	C	18	C	28	C	38	A	48	D
9	C	19	B	29	D	39	B	49	C
10	D	20	C	30	B	40	D	50	C

EXPLANATORY NOTES

Q.1 ... in which momentum and kinetic energy remain ...

Q.2 Using Charle's law $\frac{P'}{P} = \frac{T'}{T}$

$\Rightarrow P_2 = \frac{P_1 T_2}{T_1} = \frac{P(273+927)}{(273+27)} = 4P$

Q.3 $\frac{V_2}{V_1} = \frac{T_2}{T_1} \Rightarrow T_2 = 2 \times T_1 = 2 \times (273+0) = 546K$

$\Rightarrow T_2 = 273 \times 2 = 546K \Rightarrow 273°C \Rightarrow 273°C$

Q.4 Pressure is directly proportional to mean K.E $\left(P = \frac{2}{3}\frac{N}{V} < \frac{1}{2} m v^2 >\right)$

Q.5 $P \propto < K.E >$

$P \propto T \propto < K.E >$

Q.6 As the K.E increases rate of collision increases and hence heat increase hence K.E of molecule appear as heat.

Q.7 As the temperature increases, the average molecular velocity increases. This increase collisions frequency

Q.8 $E'/E = (273+327)/(273+27) = 600/300$

$E' = 2E$

Q.9 KMT is for ideal gases, condition of an ideal gas is low pressure high temperature. It breaks down at high pressure and low temperature.

Q.10 $V_{rms} = \sqrt{\frac{V_1^2 + V_2^2 + V_3^2 + V_4^2}{4}}$

$= \sqrt{\frac{(1 \times 10^3)^2 + (3 \times 10^3)^2 + (5 \times 10^3)^2 + (7 \times 10^3)^2}{4}}$

$= \sqrt{\ldots} = \ldots.6 \times 10^3\ ms^{-1}$

Q.11 In KMT collision among gas molecules and with walls of container in perfectly elastic

Q.12 $P = \frac{2}{3} \ldots K.E$

... number of molecule per unit volume.

Q.13 $P = \frac{2}{3} N < \frac{1}{2} m v^2 >$

$P' = \frac{2}{3} N < \frac{1}{2}\left(\frac{m}{2}\right) 4 v^2 >$

$P' = 2\left[\frac{2}{3} N < \frac{1}{2} m v^2 >\right]$

$P' = 2P$

Q.14 $P = \frac{2}{3} \frac{N}{V} < K.E >$

$P = \frac{2}{3} N_0 < K.E >$

Q.15 $\text{Pressure} = \left(\frac{\frac{\Delta p}{\Delta t}}{\text{Area}}\right)$

Q.16 We know that pressure on the surface by one particle is given by

$P = \frac{2mv/t}{A} \Rightarrow \text{unit area} = 1\,m^2 \Rightarrow P = \frac{2mv}{t}$

Pressure exerted by n particles is given

$P = n\left(\frac{2mv}{t}\right)$

$P = \frac{n2mv}{(1)} = t = 1\sec$

$P = 2mnv$

Q.17 $P = \frac{1}{2}\rho < K_a E > \Rightarrow \rho = \text{same}$

Q.18 Molecules do not exert force on each other except during a collision.

Q.19 The average kinetic energy of a gas molecule depends only on the absolute temperature of the gas and is directly proportional to it.

Q.20 $v_{rms} = \sqrt{\left(\frac{RT}{M}\right)}$

For constant temperature.

$\frac{(v_{rms}(H_2))}{(v_{rms}(O_2))} = \sqrt{\frac{M_{(O_2)}}{M_{(H_2)}}} = \sqrt{\left(\frac{32}{2}\right)} = 4:1$

Q.21 $P = F/A$

Q.22 $PV = nRT$

For molar volume $n = 1$ number of mole

$PV_m = 1RT \Rightarrow V_m = \frac{RT}{P}$

Q.23 Given

$V_s = 2V$

$P_s V_s = n_s RT_s \rightarrow (1)$

$P_s V_s = n_s RT_s \rightarrow (2)$

Dividing Eq. (1) & (2)

$\frac{P_s V_s}{P_s V_s} = \frac{n_s \cancel{R} T_s}{n_s \cancel{R} T_s}$

[illegible]

Q.24 $\frac{PV}{2} = RT \Rightarrow Pv = 2RT$

We know

$PV = nRT$

$\frac{PV}{n} = RT$

number of moles = 2

$\because$ volume of 2 mole of gas

Q.25 In K.M.T, distance between gas molecules is very large as compared to size of molecule inter-particle interaction is zero.

Q.26 $PV = nRT$ General gas equation.

Q.27 $PV = nRT$ for ideal gas.

Q.28 $V \propto T$, $P = \text{constant}$

From above relative, graph between V & T is straight line.

Q.29 $T \propto \langle K.E \rangle$

Q.30 $P \propto \langle K.E \rangle$

Q.31 $T \propto \langle K.E \rangle$

$\frac{E_2}{T_1} = \frac{E_2}{T_2}$ $\because \langle K.E \rangle = E$

$\frac{T_2}{300} = \frac{2E_1}{E_1}$ $T_1 = 27 + 273$

$T_1 = 300k$

$T_2 = 600k$

$T_2 = 600 - 273$

[illegible]

Q.32 Postulate of KMT, collision is elastic.

Q.34 For deriving the equation for pressure of a gas we consider the linear motion of molecule

Q.36 Accordign to Boyle's law $P \propto \frac{1}{V}$ T = constant

Q.38 an ideal gas molecule don't exert force on each other so P.E = 0. So molecules only possess

Q.39 $\Delta P = P_f - P_i = -mv - mv = -2mv$

Q.40 T = constant, $P \propto \frac{1}{V} \Rightarrow PV$ = constant

Q.41 $P \propto \frac{1}{V}$. (According to Boyle,s law)

Q.42 From Charles's law,

$V_1/T_1 = V_2/T_2$

$47.5/(0+273) = 67/T_2$

$T_2 = (67 \times 273)/47.5 = 385K$

$T_2 = 112°C$

Q.43 From Boyle's law,

$P_1 V_1 = P_2 V_2$

$1 \times 10 = 4 \times V_2$

$V_2 = 10/4 = 2.5cc$

Q.44 Using Charle's law,

$V_1/T_1 = V_2/T_2$

$V_2 = (T_2/T_1) \times V_1 = ((273+627))/((273+27)) \times 4 = 900/300 \times 4 = 12m^3$

Q.45 ... R here ...

... temperature ...

Q.46 ...

... So ΔE = maximum

Q.47 ... an ideal gas is pressed at a constant temperature, its internal energy remains the same because the internal energy of the gas depends only on its temperature

Q.48 ...

Q.49 ...

Q.50 ...

$C_p = C_v + R = 7R/2$ ...

... $) = 7/5$

PAST PAPER MCQ's (2008-2019)

[illegible]

Q. 1 **The value of universal; Gas Constant 'R' is;**

A) 8.314 $Jmol^{-1}K^{-1}$ C) 1.38 $Jmol^{-1}K^{-1}$

B) 1.38 $Jmol^{-1}K^{-2}$ D) 8.314 $Jmol^{-1}K^{-1}$

2010

Q. 2 **The value of universal gas constant is**

A) 8.314 $Jmol^{-1}K^{-1}$ C) 7.23 $Jmol^{-1}K^{-1}$

B) 8.324 $Jmol^{-1}K^{-1}$ D) 1.00 $Jmol^{-1}K^{-1}$

Q. 3 **Which one of the following is a postulate of kinetic theory of gases?**

A) Molecules do not exert force on each other

B) The size of molecules is much larger than separation between the molecules

C) A finite volume of gas consists of a very small number of molecules

D) The gas molecules are not in random motion

2011

Q. 4 **Which of the following is the expression of root mean square speed of a gas having number of molecules contained in the container?**

A) $\sqrt{\frac{v_1^2+v_2^2+...+v_N^2}{N}}$ C) $\frac{v_1^2+v_2^2+...+v_N^2}{N}$

B) $\sqrt{\frac{v_1+v_2+...+v_N}{N}}$ D) $\frac{v_1+v_2+...+v_N}{N}$

Q. 5 **For a gas of volume V in its equilibrium state, if the pressure does change with time th... total kinetic energy of gas is constant because**

A) Collisions between gas molecules occur

B) Collisions between gas molecules occur linearly

C) Collisions must be elastic

D) Collisions must be inelastic

2012

Q. 6 **Which of the following is expression of mean square speed of 'N' gas molecu... contained in a cylinder?**

A) $\frac{v_1^2+v_2^2+......v_N^2}{N}$ C) $\sqrt{\frac{v_1+v_2+......v_N}{N}}$

B) $\frac{v_1+v_2+......v_N}{N}$ D) $\sqrt{\frac{v_1^2+v_2^2+......v_N^2}{N}}$

Q. 7 **H_2 and O_2 both are at thermal equilibrium at temperature 300 K, Oxygen molecule... times massive than hydrogen, Root mean square speed of hydrogen is:**

A) 4 times root mean square of oxygen C) $\frac{1}{16}$ root mean square of oxygen

B) $\frac{1}{4}$ root mean square of oxygen D) 16 root mean square of oxygen

2013

Q. 8 A gas sample contains three molecules each having speeds 1m/s, 2m/s and 3m/s. What is the mean square speed?

A) 14/3 m/s

B) 6m/s

C) 2m/s

D) $\sqrt{14/3}$ m/s

Q. 9 What is the factor upon which change in internal energy and ideal gas depends?

A) Change in volume

B) Changed in volume and temperature

C) Change in temperature

D) Path followed to change internal energy

Q. 10 The value of universal gas constant is:

A) 8.314 J $mol^{-1}K^{-1}$

B) 8.32 J $mol^{-1}K^{-1}$

C) 100 J $mol^{-1}K^{-1}$

D) 1.38×10^{-23} J $mol^{-1}K^{-1}$

2014

Q. 11 A gas containing N number of molecules of gas having mass of each molecule is m in a cubic container having length of each side a. what is the density of gas contained in cube?

A) N/a^2

B) m/a^3

C) Nm/a^3

D) Na^3/m

2015

Q. 12 In general gas equation PV = nRT, n represents the number of moles of gas. Which of the following represents the relation of n?

A) $n = NN_A$

B) $n = N/N_A$

C) $n = N_A/N$

D) $n = N+N_A$

Q. 13 Root mean square velocity of a gas having pressure 'P' and density 'ρ' is given by

A) $\sqrt{\frac{3P}{\rho}}$

B) $\frac{3P}{\rho}$

C) $\frac{3\rho}{P}$

D) $\sqrt{\frac{3\rho}{P}}$

2016

Q. 14 The relation $\frac{R}{N_A} = 1.38\times10^{-23} JK^{-1}$ in a gas law is known as

A) Avogadro's constant

B) Charles constant

C) Newton's constant

D) Boltzmann's constant

Q. 15 In general gas equation PV = nRT, n represents the number of moles of gas. Which of the following represents the relation of n?

A) $n = NN_A$

B) $n = N/N_A$

C) $n = N_A/N$

D) $n = N+N_A$

2017

Q. 16 Estimate pressure of air molecules at 273K, if the mean square speed is $<v^2> = 500m^2s^{-2}$ and density of air under these conditions is $6kg/m^3$:

A) 2.5×10^2 Pa

B) 1×10^3 Pa

C) 1×10^2 Pa

D) 2.7×10^3 Pa

Q. 17 One mole of a gas occupies volume 1×10^{-2} m^3 in cylinder whose pressure is 2.5×10^5 Pa. The temperature of cylinder will be equal to:

A) 300K

C) 370K

D) 390K

2017

Q. 18 The rms speed of gas molecules is:

A) $\sqrt{\frac{m}{3kT}}$ C) $\sqrt{\frac{3kT}{m}}$

B) $\frac{m}{3kT}$ D) $\left(\frac{m}{3kT}\right)$

2018

Q. 19 Find the mean translational kinetic energy of ideal hydrogen gas at 17°C.

A) 6.21×10^{10} J C) 6.21×10^{-21} J

B) 5×10^{-21} J D) 6×10^{-21} J

Q. 20 If one mole of an ideal gas is heated at constant pressure, then the first law of thermodynamics can be written as:

A) $C_p\Delta T = C_v\Delta T + P\Delta V$ C) $C_p\Delta T = C_v\Delta T + V\Delta P$

B) $C_v\Delta T = C_p\Delta T + P\Delta T$ D) $\Delta C_v T = \Delta C_v T + P\Delta V$

Q. 21 *If* $C_v = 5/2\ R$, C_p will be

A) $\frac{5}{5}R$ C) $\frac{5}{2}R$

B) $\frac{2}{7}R$ D) $\frac{7}{2}R$

2019

Q. 22 The sum of all forms of molecular energies (kinetic and potential) of a substance is termed as?

A) internal energy C) heat energy

B) elastic energy D) absolute energy

Q. 23 Molecules of a gas at constant pressure for a fixed amount of gas have average kinetic energy X. Increasing temperature from 27°C to 327°C, average K.E. of molecules will become:

A) 200 X C) 300 X

B) 20 X D) 2 X

ANSWER KEY

1	D	11	C	21	D
2	A	12	B	22	A
3	A	13	A	23	D
4	A	14	D		
5	C	15	B		
6	A	16	B		
7	A	17	A		
8	A	18	C		
9	C	19	D		
10	A	20	A		

EXPLANATORY NOTES

Q.1 Value of 'R' is 8.314 J $mol^{-1}k^{-1}$

Q.2 Value of 'R' =8.314 J $mol^{-1}k^{-1}$

Q.3 Molecules do not exert force on each other.

Q.4 $v = \sqrt{\frac{v_1^2 + v_2^2 + \ldots + v_N^2}{N}}$

Q.5 For a gas of volume V in its equilibrium state, of pressure does not change with time then total K.E of gas is constant because collision must be elastic.

Q.6

$v = \frac{v_1 + v_2 + \ldots + v_N}{N}$

Q.7 $v_{rms} = \sqrt{\frac{3RT}{M}}$ at T = same for both.

$\frac{v_{rms\,1}}{v_{rms\,2}} = \sqrt{\frac{M_2}{M_1}} = \sqrt{\frac{1}{16}} = \frac{1}{4} \Rightarrow v = \frac{1}{4} v_H \Rightarrow v_H = 4v_o$

Q.8 $V_{rms} = \frac{1^2 + 2^2 + 3^2}{3} = \frac{14}{3}$

Q.9 Change in internal energy an ideal gas is depend on temperature according to given options.

Q.10 R = 8.314 J $mol^{-1}K^{-1}$

Q.11 $\rho = \frac{\text{mass of gas}}{V} = \frac{mN}{a^3}$

Q.12 n = number of moles. $n = N/N_A$

Q.13 $P = \frac{\rho}{3} v^2 \Rightarrow v^2 = \frac{3P}{\rho} \Rightarrow v_{rms} = \sqrt{\frac{3P}{\rho}}$

Q.14 Boltzmann constant $= \frac{R}{N_A} = 1.38 \times 10^{-23} J/K^{-1}$

Q.15 n = number of moles. $n = N/N_A$

Q.16 [illegible] $\times 500 = 10^5 Pa$

Q.17 PV = RT for n = 1 [illegible] $\frac{PV}{R} = \frac{(2.5 \times 10^5)(10^{-2})}{8.314} = 300K$

Q.18 [illegible]

Q.19 [illegible]

T = 17 + 273 = 290 K

[illegible]

Q. 20 $Q_p = \Delta U + W$

$Q_p \Delta T = C_v \Delta T + P\Delta V$

Q. 21

$C_p = C_v + R$

$= \frac{5R}{2} + R = \frac{5R + 2R}{2} = \frac{7R}{2}$

Q. 22 Definition of internal energy.

Q. 23 Here $T_1 = 27°C = 300K$, $T_2 = 327°C = 600K$

$T = \frac{2}{3k} < K.E > \Rightarrow \frac{T_1}{T_2} = \frac{< K.E >}{< K.E' >} = \frac{x}{x'} = \frac{300}{600} = \frac{1}{2} \Rightarrow x' = 2x$

TOPIC-9 ELECTROSTATICS

PRACTICE EXERCISE

TOPIC-WISE MCQ's

COULOMB'S LAW

Q.1 If F is the force between two points charges submerged in a medium of dielectric constant K, then on removing the medium, the force between the charges becomes

A) $F \times K$

B) FK

C) $\frac{1}{\sqrt{K}}$

D) $\frac{F}{K}$

Q.2 If the distance between two-point charges to becomes double then the coulomb's force will be

A) $\frac{F}{2}$

B) 2F

C) 4F

D) $\frac{F}{4}$

Q.3 The force between two point charges placed in air is F. if air is replaced by a medium of relative permittivity ε_r, the force is reduced to

A) $\varepsilon_r F$

B) $\frac{F}{\varepsilon_r}$

C) $\frac{\varepsilon_r}{F}$

D) ε_r

Q.4 Two point charges are separated by a distance of 4 m. The force between them is 4 N. What is the force between the charges, when the distance between them is 1 m

A) 16 N

B) 1 N

C) 64 N

D) 32 N

Q.5 Two identical metal balls with charges + 2Q and -Q are separated by some distance, and exert a force F on each other. They are joined by a conducting wire, which is then removed. The force between them will now be.

A) F

B) F/4

C) F/2

D) F/8

Q.6 When 10^{19} electrons are removed from a neutral metal plate, the electric charge on it is (coulomb)

A) 10^{19}

B) 1.6

C) –1.6

D) 10^{19}

Q.7 Two point charges $+3\mu C$ and $+8\mu C$ repel each other with a force of 40N. If a charge of $-5\mu C$ is added to each of the, then the force between them will become:

A) –10 N

B) [illegible] N

C) +20 N

D) –20 N

Q.8 Two point charges +2 C and +6 C repel each other with a force of 12 N. If a charge of -2 C is given to each of these charges, the force will now be

A) zero

B) 8 N (attractive)

C) 8 N (repulsive)

D) 16 N (attractive)

Q.9 Relative permittivity of a material is 10. It's absolute or actual permittivity is

A) 8.85×10^{-12} F/m

B) 8.85×10^{-11} F/m

C) $9\times10^{[illegible]}$ F/m

D) 10 F/m

Q.10 Two electrons are removed from a conductor the charge on it is

A) 1.6×10^{-19} C

B) [illegible]

C) 3.2×10^{-19} C

D) neutral

ELECTRIC FIELD STRENGTH $E = \dfrac{Q}{4\pi\varepsilon_0 r^2}$ FOR THE FIELD STRENGTH

Q.11 The magnitude of electric intensity E is such that an electron placed in it would experience an electrical force equal to its weight. E is given by

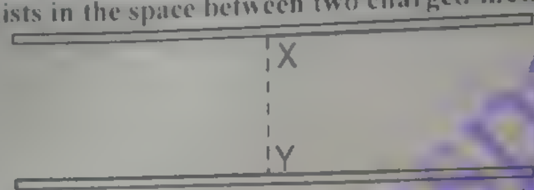
A) mge

B) $\dfrac{e}{mg}$

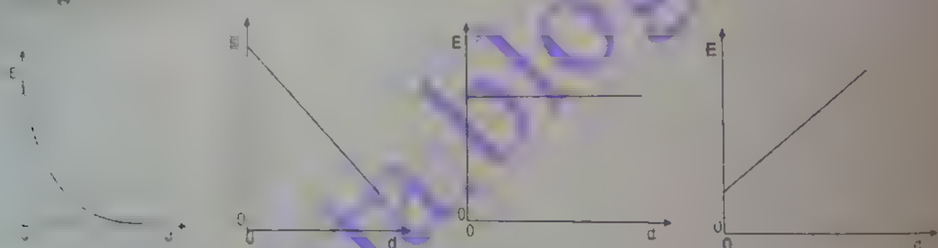
C) $\dfrac{mg}{e}$

D) $\dfrac{e^2g}{m^2}$

Q.12 An electric field exists in the space between two charged metal plates.



Which graph shows the variation of electric field strength E with distance d from X along the line XY?



A) B) C) D)

Q.13 The electric field intensity at a point 20 cm away from a charge of 2×10^{-6} C is

A) 4.5×10^{6} N/C

B) 3.5×10^{6} N/C

C) 3.5×10^{5} N/C

D) 4.5×10^{5} N/C

Q.14 The weight of proton (mass = 1.67×10^{-27} kg) on entering in a vertical electric field is balanced by electric force. Then the electric field strength is

A) $10^{[illegible]}$ V m^{-1}

B) $10^{[illegible]}$ V m^{-1}

C) 10^{-7} V m^{-1}

D) 10^{-8} V m^{-1}

Q.15 A hollow sphere of copper is positively charged. Then the electric field inside the sphere is

A) the same as the field at the surface

B) less then the field at the surface but not zero

C) greater than the field at the surface

D) zero

Q.16 Two metal plates have potential difference of 300 V and are 0.01 m apart. A charged particle of mass 1.96×10^{-15} kg is held in equilibrium between the plates of the capacitor. Then the electric field is

A) 3×10^{2} V m^{-1}

B) 3 V m^{-1}

C) 3×10^{4} V m^{-1}

D) 3×10^{-4} V m^{-1}

The electric field strength between a pair of parallel plates is E. The separation of the plates is doubled and the potential difference between the plates is increased by a factor of four. What is the new electric field strength?

C) 4 E

D) 8 E

TO CALCULATE THE FIELD STRENGTH

Q.18 Two plates are 2cm apart. If a potential difference of 10 volt s is applied between the plates. The electric field between the plates will be

A) 20 N/C

C) 500 N/C

D) 250 N/C

Q.19 Two plates are 1 cm apart and the potential difference between them is 10 volts. The electric field between the plates is

B) 500 N C^{-1}

C) 1000 N C^{-1}

D) 250 N C^{-1}

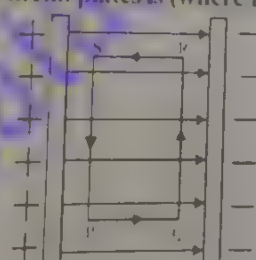
Q.20 Electric field strength at a point between oppositely charge plates is E. If the distance between plates is reduced to half, what will be the new value of electric intensity?

C) E/4

D) 2E

ELECTRIC FIELD LINES

Q.21 The amount of work done in joule in carrying a charge +q along the closed path PQRSP between the oppositely charged metal plates is (where E is electric field between the plates)



A) Zero

C) q

B) $qE(PQ + QR + SR + SP)$

D) $\frac{q}{\varepsilon_0}$

Q.22 A charged conductor has charge on its

A) Outside surface

C) Middle point

D) Inner surface

Q.23 Neutral zone in electric field of two similar charges is region where

A) ... charges are present

B) Equal quantity of both positive and negative charges are present

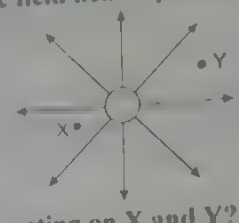
C) An electric dipole exists

D) No electric field line passes

Q.24 Which diagram represents the electric field in the vicinity of a positive electric charge of magnitude Q?

A) B) C) D)

Q.25 The diagram shows the electric field near a point charge and two electrons X and Y



Which row describe the forces acting on X and Y?

	direction of force	magnitude of force on X
A)	radially inwards	less than force on Y
B)	radially inwards	greater than force on Y
C)	radially outwards	less than force on Y
D)	radially outwards	greater than force on Y

Q.26 A charged particle of mass 0.003 gm is held stationary in space by placing it in downward direction of electric field of 6×10^4 N/C. Then the magnitude of the charge is

A) 5×10^{-4}C
C) -18×10^{-6}C
B) $5\times10^{[illegible]}$ C
D) $-5\times10^{[illegible]}$C

ELECTRIC POTENTIAL

Q.27 Two charged spheres of radii 10 cm and 15 cm are connected by a thin wire. No current will flow, if they have:

A) The same charge on each
C) The same energy
B) The same potential
D) The same field on their surface

Q.28 12 J of work is to be done against an existing electric field to take a charge of 0.01 C from A to B. Find The potential difference between B and A.

A) [illegible] V
C) 1.2 V
B) 200 V
D) 12 V

Q.29 A and B are two points in an electric field. If the work done in carrying 4.0 coulomb of electric charge from A to B is 16.0 joule the potential difference between A and B is

A) [illegible]
C) 4 V
B) 2.0 V
D) 16V

Q.30 Potential due to charge q at distance 1m is 5V, at distance 3m will be

A) [illegible]
C) $\frac{7}{3}$ V
B) [illegible]
D) $\frac{3}{7}$ V

The electric potential at the surface of an atomic nucleus ($Z = 50$) of radius 9.0×10^{-15} m

A) 9 V

B) 9×10^{5} V

C) 8×10^{6} V

D) 80 V

Q.32 A capacitor with air as the dielectric is charged to a potential of 100 volt. If the space between the plate is now filled with a dielectric of dielectric constant 10, the potential difference between the plates will be

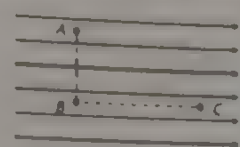
A) 1000 V

B) 100 V

C) 10 V

D) 0 V

Q.33 Figure shows three points A, B and C in a region of uniform electric field E. The line AB is perpendicular and BC is parallel to the field lines. Then which of the following holds good. Where V_A, V_B and V_C represent the electric potential at points A, B and C respectively



A) $V_A = V_B = V_C$

B) $V_A = V_B > V_C$

C) $V_A = V_B < V_C$

D) $V_A > V_B = V_C$

Q.34 Value of potential at a point due to a point charge is

A) Inversely proportional to square of the distance

B) Directly proportional to square of the distance

C) Inversely proportional to the distance

D) Directly proportional to the distance

Q.35 When one electron is taken towards the other electron, then the electric potential energy of the system

A) Decreases

B) Increases

C) Remains unchanged

D) Becomes zero

GRAVITATIONAL FORCE AND ELECTRIC FORCE

Q.36 Electrostatic force is a______ force

A) attractive

B) may be attractive or repulsive

C) repulsive force

D) none of these

Q.37 Electrostatic force as compared to the gravitational force is

A) Very weak

B) equal

C) very strong

D) half of the gravitational field

CAPACITANCE OF A CAPACITOR

Q.38 What is the area of the plates of a $3F$ parallel plate capacitor, if the separation between the plates is $5mm$

A) $1.694 \times 10^{9}\ m^2$

B) $1.520 \times 10^{9}\ m^2$

C) $9.281 \times 10^{9}\ m^2$

D) $12.981 \times 10^{9}\ m$

Q.39 The capacity of a condenser in which a dielectric of dielectric constant 5 has been used, is C. If the dielectric is replaced by another with dielectric constant 20, the capacity will become

A) $\frac{C}{4}$

C) $\frac{C}{2}$

D) $4C$

Q.40 [illegible] capacitance C is connected to battery of emf V_0. Without removing the [illegible] dielectric of strength ε_r is inserted between the parallel plates of the capacitor [illegible] then the charge on the capacitor is

[illegible]
C) $\frac{CV_0}{\varepsilon_r}$

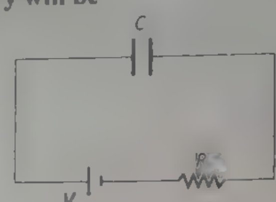
[illegible] CV_0
D) none of these

Q.41 The space between the plates of a capacitor is filled by a dielectric constant k. The capacitance of the capacitor

[illegible] by a factor k
C) decreases by a factor k

B) [illegible] by a factor k^2
D) decreases by a factor k^2

Q.42 As in figure shown, if a capacitor C is charged by connecting it with resistance R, then energy is given by the battery will be



A) $\frac{1}{2}CV^2$
C) Less than $\frac{1}{2}CV^2$

B) More than $\frac{1}{2}CV^2$
D) Zero

Q.43 A capacitor of capacitance 2μF is connected with a battery of 12 volt, the charge stored is equal to:

A) 2.5×10^{-5} C
C) 2.4×10^{-6} C

B) 2.4×10^{-5} C
D) 2.5×10^{5} C

Q.44 If an insulating material called dielectric is introduced between the plates, the capacitance of capacitor is:

A) $\frac{A\varepsilon_o\varepsilon_r}{2d}$
C) $\frac{A\varepsilon_o\varepsilon_r}{d}$

B) $\frac{Ad}{\varepsilon_o\varepsilon_r}$
D) $\frac{2Ad\varepsilon_o\varepsilon_r}{d}$

Q.45 If a 2 μF capacitor has a charge of 20 μC, the potential difference between the plates is

A) 10 V
C) 20 V

B) 40 V
D) 50 V

Q.46 Capacitance with air is 10F, if a dielectric of $\varepsilon_r = 100$ is inserted then new capacitance

A) 1000 F
C) 10 μF

B) 10 F
D) 100 F

ENERGY STORED IN CAPACITOR

Q.47 The energy stored between the plates of a capacitor in not represented by

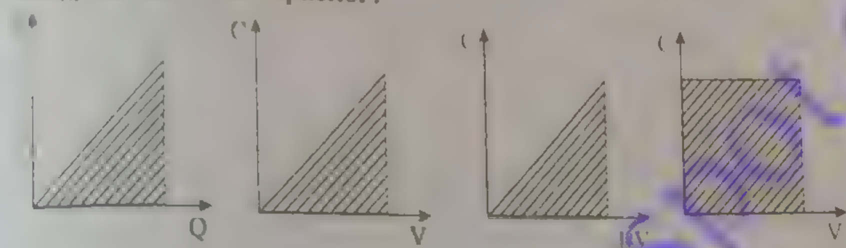
A) $U = \frac{CV}{2}$
C) $U = \frac{q^2}{2C}$

B) $U = 2qV$
D) $U = \frac{qV}{2}$

If the potential difference across the two plates of a parallel plate capacitor is doubled then its energy stored in it will be:

A) 2 times
B) 6 times
C) 4 times
D) remains same

Q.49 The energy stored in a capacitor of capacitance C, carrying charge Q with potential difference V between its plates, may be obtained by calculating the area under an appropriate graph. Which graph shows the correct relationship between a pair of the quantities C, Q and V, and in addition shows a shaded area which corresponds to the energy stored in the capacitor?



A) B) C) D)

Q.50 If a 10 F capacitor is to have an energy content of 20 J, it must be placed across a potential difference of

A) 4 volts
B) 9 volts
C) 2 volts
D) 1 volt

ANSWER KEY

1	B	11	C	[illegible]	A	[illegible]	C	41	A
2	D	12	C	[illegible]	A	[illegible]	C	[illegible]	B
[illegible]	B	[illegible]	A	[illegible]	D	[illegible]	B	43	B
[illegible]	C	[illegible]	C	[illegible]	A	[illegible]	C	[illegible]	C
[illegible]	D	[illegible]	D	[illegible]	B	[illegible]	B	[illegible]	A
[illegible]	B	[illegible]	C	[illegible]	B	[illegible]	B	[illegible]	A
[illegible]	A	[illegible]	B	[illegible]	B	[illegible]	C	[illegible]	C
[illegible]	A	[illegible]	C	[illegible]	B	[illegible]	A	[illegible]	C
[illegible]	B	[illegible]	C	[illegible]	C	[illegible]	B	[illegible]	A
[illegible]	B	[illegible]	D	[illegible]	A	[illegible]	B	[illegible]	C

EXPLANATORY NOTES

Q.1 As.

$$F = \frac{F'}{\epsilon_r} = \frac{F'}{K} \quad \therefore \epsilon_r = K$$

$$F = KF$$

Q.2 If $r \to 2r$

$$F = \frac{kq^2}{r^2} \Rightarrow F' = \frac{F}{4}$$

Q.3 $F = \frac{kq_1q_2}{r^2}$

$$F = \frac{1}{4\pi \epsilon \epsilon_r} \times \frac{q_1q_2}{r^2} \Rightarrow F' = \frac{F}{\epsilon_r}$$

Q.4 $F = \frac{kq_1q_2}{r^2} \Rightarrow F \propto \frac{1}{r^2}$

$$\frac{F_1}{F_2} = \frac{r_2^2}{r_1^2} = \left(\frac{r_2}{r_1}\right)^2$$

$$\frac{4}{F_2} = \left(\frac{1}{4}\right)^2 = \frac{1}{16}$$

$$F_2 = 4 \times 16 = 64\text{ N}$$

Q.5 When two balls are connected by a conducting wire the net charge is (2Q–Q) i.e Q and Q divided equally between two balls.

$F \propto 2Q^2$ ______(i)

$F' \propto \left(\frac{Q}{2}\right)^2$ ---(ii)

Dividing equation (ii) by equation (i)

$$\frac{F'}{F} = \frac{Q^2/4}{2Q^2} = \frac{1}{8}$$

$$\boxed{F' = \frac{1}{8}F}$$

Q.6 As electric charge on electron is

$Q = 1.6 \times 10^{-19}\text{ C}$

If 10^{+19} electrons removed from a neutral plate, then electric charge is + 1.6 C.

Q.7 In second case, charges will be $-2\mu C$ and $+3\mu C$ Since $F \propto Q_1Q_2$ i.e.

$$\frac{F}{F'} = \frac{Q_1Q_2}{Q_1'Q_2'} = \frac{40}{F'} = \frac{3\times 8}{-2\times 3} = -4F' = 10\text{ N (Attractive)}$$

Q.8 Because +2C charge will become neutral with -2C charge

Q.9 [illegible]

Q.10 If two electron are removed from a conductor the charge on it is equal to 2 proton

$+2e = 2\times1.6\times10^{-19}$ C

$= 3.2\times10^{-19}$ C

Q.11 $F = F$

$eE = mg$

$E = \frac{mg}{e}$

Q.12 Electric field between two oppositely charged plates is uniform.

Q.13 $E = \frac{kq}{r^2} = \frac{9\times10^9\times2\times10^{-5}}{(20\times10^{-2})^2}$

$E = 4.5\times10^6\,N/C$

Q.14 $E = \frac{F}{q} = \frac{mg}{q} = \frac{1.67\times10^{-27}\times10}{1.6\times10^{-19}} = 10^{-7}\,Vm^{-1}$

Q.15 $\phi = \frac{q}{\epsilon_0} = \frac{0}{\epsilon_0} = 0$

$\phi = E \cdot A = 0 = E.A$

Where $A \neq 0$, $E = 0$

Q.16 As

$E = \frac{\Delta V}{\Delta r}$

$E = \frac{300}{0.01} = 30000 = 3\times10^4\,Vm$

Q.17 $E = \frac{\Delta V}{\Delta r} = \frac{4\Delta V}{2\Delta r}$

$E = 2E$

Q.18 $E = \frac{\Delta V}{\Delta r} = \frac{10}{[illegible]} = 500\,N/C$

Q.19 $E = \frac{\Delta V}{\Delta r} = \frac{[illegible]}{[illegible]} = 1000\,N/C$

Q.20 $E = \frac{V}{d}$, $d \to \frac{1}{2}d$ at V = constant $\Rightarrow E = 2E$

Q.21 Work done in conservative field is zero in a closed path

Q.22 A charged conductor has charge always on its surface

Q.23 [illegible] field lines passes

[illegible] always away from positive charge

[illegible]

$\frac{0.03\times10 \times 10}{[illegible]} = 5\times10 \, C$

[illegible] current flows from higher potential to lower potential.

[illegible] $= 1200\,V$

$\frac{W}{q} = \frac{16}{4} = 4\,V$

$V = \frac{kq}{r}$

$\frac{q_1}{q_2} = \frac{r_1}{r_2}$

[illegible] $\times V_1 \Rightarrow V_2 = [illegible] \times 5 \Rightarrow V_2 = [illegible]$

Q.31 [illegible]

Q.32 [illegible]

[illegible] force may be attractive or repulsive [illegible]

Q.38 We have $C = \frac{\varepsilon A}{d} \Rightarrow A = \frac{Cd}{\varepsilon} = \frac{3\times5\times10^{[illegible]}}{8.85\times10^{[illegible]}}$ [illegible]

Q.39 $\Rightarrow \frac{C_1}{C_2} = \frac{5}{20} \Rightarrow C_2 = 4C$

Q.40 As, $Q = CV \rightarrow$ also $C = \epsilon_r C$ and $V = V_o$ then $Q = \epsilon_r CV_o$

Q.41 [illegible]

Q.42 Energy stored in a capacitor and some loss of energy in the form of heat in resistance.

Q.43 $Q = CV$

$Q = 2\times10^{-6}\times12$

$Q = 24\times10^{-6}$ C

Q.44 $C = \frac{A\epsilon_o}{d}$

Q.45 $Q = CV$

$V = \frac{Q}{C} = \frac{20\times10^{-6}}{2\times10^{-6}} = 10$ volt

Q.46 As,

$C_{med} = \epsilon_r \times C_{vac}$

$C = 100\times10$

$C = 1000$ F

Q.47 As we know,

$U_m = \frac{1}{2}CV^2 = \frac{Q^2}{2C} = \frac{qV}{2}$

but $U_m \neq 2qV$

Q.48 $E = \frac{1}{2}CV^2 \Rightarrow E \propto V^2$

$V' = 2V$

$E' = 4E$

Q.49 $Q = CV$

As C is constant, it may be found by $V - Q$ graph. Then we can find energy by

$U = \frac{1}{2}CV^2$

Q.50 As we know,

[illegible] volt

PAST PAPER MCQ's (2008-2019)

[illegible]

Q. 1 A particle carrying charge of 2e falls through a potential difference of 3.0 V. Calculate energy required by it:

A) 9.6×10^{-19} J
C) 1.6×10^{-19} J
B) [illegible] J
D) 6.0×10^{-19} J

Q. 2 The work done in moving a unit positive charge from one point to another against electric field is a measure of:

A) Capacitance
C) Intensity of electric field
B) Potential difference between two points
D) Resistance between two points

2010

Q. 3 Electric intensity is a vector quantity and its direction is

A) Perpendicular to the direction of field
B) Opposite to the direction of force
C) At a certain angle
D) Along the direction of force

Q. 4 The magnitude of an electric field between two separated plates can be calculated by the Relation

A) $\Delta V = Ed$
C) $\Delta V = [illegible]d$
B) $\Delta V = E/d$
D) $E = \Delta V$[illegible]

2012

Q. 5 10 V potential difference is applied across the plates of 1 F capacitor. What is the energy stored in capacitor?

A) 0.5 mJ
C) 5 J
B) 0.05 mJ
D) 50 J

Q. 6 What will be the effect on the capacitance of a capacitor if area of each plate is doubled with separation between the plates is halved?

A) Capacitance remains same
C) Capacitance becomes four times
B) Capacitance becomes double
D) Capacitance reduces of half

2013

Q. 7 What is the charge stored on a 5μF capacitor charged to the potential difference of [illegible]

A) [illegible]
C) 2.4μC
B) 2.4[illegible]
D) 60.C

2014

Q. 8 The distance between the plates of a parallel plate capacitor is 2.0 mm and area of plates is 2.0 m². A potential difference of 1.0×10^{4} V is applied across the plates [illegible] the capacitance.

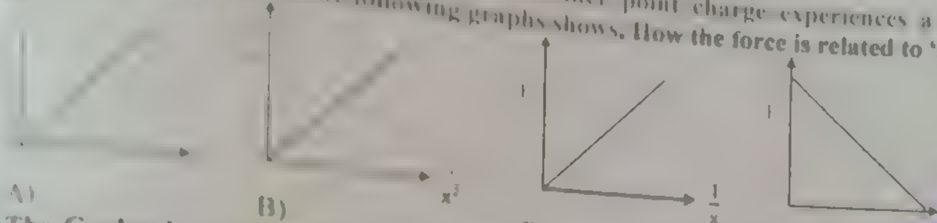
A) [illegible]
C) 8.85×10^{-9}F
B) 3.54×10^{-9}F
D) 9.0×10^{-4}F

2016

Q. 9 If the length, width and separation between the plates of a parallel plate capacitor [illegible] doubled then its capacitance becomes

A) [illegible]
C) [illegible]
B) [illegible]
D) [illegible]

Q. 10 A point charge at a distance 'x' from another point charge experiences a force of repulsion which one of the following graphs shows. How the force is related to 'x':



Q. 11 The Coulomb force between two charges $q_1 = 2C$ and q_2 is 2N, the distance between charges is 3m. What is the charge of q_2?

A) $\times 10^{9}C$

B) $1\times10^{-9}C$

C) $2\times10^{9}C$

D) $4\times10^{9}C$

Q. 12 The electric field strength at the position $r = (4\hat{i} + 3\hat{j})$m caused by a point charge of 5μC placed at origin is

A) $1240\hat{i} + 1280\hat{j}$ N/C

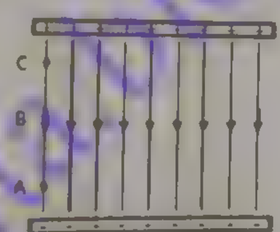
B) $1440\hat{i} + 1080\hat{j}$ V/m

C) $1440\hat{i} + 1080\hat{j}$ N/m

D) $1240\hat{i} + 1080\hat{j}$ N/C

Retake 2017

Q. 13 If a charge particle is placed one by one at point A, B and C then at which point it will experience a large force:



A) At point "A"

B) At point "C"

C) At point "B"

D) Same at all point

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Q. 14 Coulombs law is given by the formula $F = k\, q_1 q_2 / r^2$. The magnitude of k having the unit of Nm^2C^{-2} for free space is equal to

A) 9×10

B) 6×10

C) 10×10^{9}

D) 9×10^{9}

Q. 15 Force experienced per unit positive test charge at a point in an electric field is the definition of:

A) Electric potential energy

B) Electric field strength

C) Electric potential

D) Electric field

Q. 16 A torch is rated 2.2 V, 0.25 A. Calculate the charge passing through the bulb in one second and energy transferred by the passage of each coulomb of charge.

A) ... and 8.8 J

B) 0.25 C and 2.2 J

C) 0.25 C and 2.2 V

D) 0.25 C and 0.55 J

Q. 17 Electric potential due to 2 μC charge at distance of one meter is equal to

A) 18×10^{4} volt

B) 1.8×10^{6} volt

C) 8×10^{9} volt

D) 1.8×10^{4} volt

Q. 18 Electric field strength of a point charge is E and electric potential is V at a distance from the point charge. What is the electric potential at a point for the same point charge where electric field strength is E/4?

A) V/4 C) V/2

B) 4V D) 2V

Q. 19 A particle carrying a charge of 5e falls through a potential difference of 25V. What would be energy acquired by the particle in 'J'.

A) 125×10^{-19} J C) $125\times1.6\times10^{-19}$ J

B) 1.6×10^{-19} J D) 125 J

Q. 20 Electric field strength at a point between oppositely charge plates is E. If the distance between plates is reduced to half, what will be the new value of electric intensity?

A) 4E C) E/4

B) E/2 D) 2E

ANSWER KEY

1	A	11	B
2	B	12	B
3	D	13	D
4	A	14	D
5	D	15	B
6	C	16	D
7	A	17	D
8	C	18	C
9	A	19	C
10	B	20	D

EXPLANATORY NOTES

Q.1
$(2e)(3V) = 6eV$
$9.6\times10^{-19}J$

Q.2 Definition of potential difference

Q.3

Q.4

Q.5 Energy stored $= \frac{1}{2}CV^2 = \frac{1}{2}(1)(10)^2 = 50J$

Q.6 $2 - C = \frac{A\varepsilon_o}{d} \Rightarrow C' = \frac{(2A)\varepsilon_o}{\frac{1}{2}d} = 4C$

Q.7 $Q = CV = (5\times10^{-6})(12) = 60\mu C$

Q.8 $C = \frac{A\varepsilon_o}{d} = \frac{2\times8.85\times10^{-12}}{2\times10^{-3}} = 8.85\times10^{-9}F$

Q.9 Length $= l = 2l$, Width $= W = 2W \Rightarrow A' = 2l\times2W = 4A$
$C = \frac{(4A)\varepsilon}{2d} = 2C$

Q.10 $F = \frac{Kq_1q_2}{r^2} \Rightarrow F \propto \frac{1}{r^2}$

Q.11 $F = \frac{Kq_1q_2}{r^2} \Rightarrow 2 = \frac{(9\times10^9)(2)q_2}{3^2} \Rightarrow q_2 = 1\times10^{-9}C$

Q.12 $\vec{r} = (4\hat{i}+3\hat{j})m \Rightarrow |\vec{r}| = \sqrt{4^2+3^2} = 5m$

$\vec{E} = \frac{kq}{r^2}\hat{r} = \frac{kq\vec{r}}{r^2\, r} = \frac{(9\times10^9)(5\times10^{-7})(4\hat{i}+3\hat{j})}{(5)^2\times5} = (1440\hat{i}+1080\hat{j})V/m$

Q.13 Uniform electric field then at point A, B, C a charge particle will experience same force.

Q.14

Q.15

Q.16 $E = VIt = VI\times t = 2.2\times0.25\times1 = 0.55J$

Q. 18 $E \propto \frac{1}{r^2}$ for $r' = 2r \Rightarrow E' = \frac{E}{4}$

$$V \propto \frac{1}{r} \Rightarrow V' \propto \frac{1}{2r} \Rightarrow V' = \frac{V}{2}$$

Q. 19 Energy $= qV = 5e \times 25 = 125eV = 125 \times 1.6 \times 10^{-19} J$

Q. 20

$$E = -\frac{\Delta V}{\Delta r}$$

$$E \propto \frac{1}{\Delta r}$$

TOPIC-10 CURRENT ELECTRICITY

PRACTICE EXERCISE

TOPIC-WISE MCQ's

CURRENT

Q.1 **How many electrons per second constitute a current of one micro ampere?**
A) One electron
B) 10^{n} electrons
C) 10^{-6} electrons
D) 6.25×10^{12} electrons

Q.2 **A steady current is flowing in a conductor of non-uniform cross-section. The charge passing through any cross-section per unit time is**
A) Directly proportional to the area of cross-section
B) Inversely proportional to the area of cross-section
C) Proportional to square of the area of cross-section
D) Independent of the area of cross-section

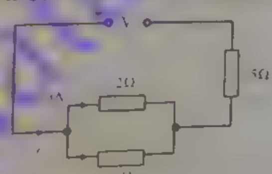
Q.3 **In the case of gases, the charge carries are**
A) Positive and negative ions
B) electrons and holes
C) negative ions and electrons
D) positive ions and electron

Q.4 **What is meant by 5 A?**
A) A charge of 5 C flows through a point in 1 second
B) 5 V electricity flows across 1Ω of resistance
C) 5V electricity is causing 1 C of charge to flow
D) A charge of 5 C flows through a point in 5 seconds.

OHM'S LAW

Q.5 **Slope of the graph between "V" On X-axis and "I" on the Y-axis is**
A) Resistance
B) Emf
C) Conductance
D) Capacitance

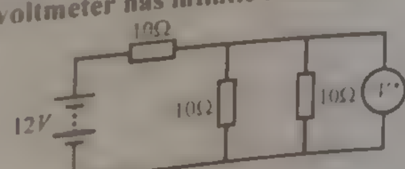
Q.6 **In the circuit shown, there is a current of 3 A in the 2 Ω resistor**



What are the values of current I delivered by, and voltage V across the power supply?

	I/A	V/V
	3	10.5
	4	9
	4	12
	12	18

Q.7 **The circuit shown, the voltmeter has infinite resistance**



What is the voltmeter reading?
C) 4 V
D) 8 V

Q.8 When we double the voltage in a simple electric circuits we double the

A) Current

C) Power

D) Both (A) and (C)

Q.9 An electric current is passed through a circuit containing two wires of the same material, connected in parallel. If the lengths and radii of the wires are in the ratio of 4:3 and 2:3, then the ratio of the currents passing through the wire will be

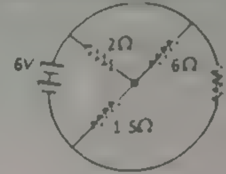
A) 3

C) 8/9

B) 1/3

D) 2

Q.10 The total current supplied to the circuit by the battery is



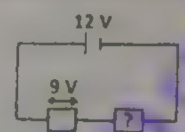
A) 1 A

C) 4 A

B) 2 A

D) 6 A

Q.11 A battery connected with two resistors in series is shown below.



If the voltage of one resistor is 9 V, what is the voltage across the other resistor?

A) 2V

C) 3V

B) 6V

D) 12V

SERIES AND PARALLEL COMBINATION OF RESISTORS

Q.12 There are 8 equal resistances R. Two are connected in parallel, such four groups are connected in series, the total resistance of the system will be

A) R / 2

C) 2 R

B) 4 R

D) 8 R

Q.13 The new resistance of wire of $R\ \Omega$, whose radius is reduced half, is

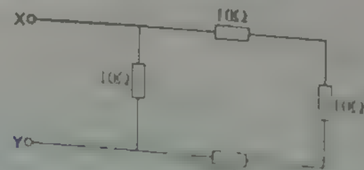
A) 16 R

C) 3 R

B) 2R

D) R

Q.14 The diagram shows an arrangement of resistors.



What is the total electrical resistance between X and Y?

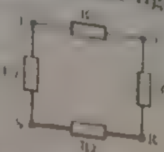
A) less than 1Ω

C) Between 10Ω and 30Ω

B) Between 1Ω and 10Ω

D) 40Ω

Q.15 Four resistors are connected as shown in the figure.



Between which two points does the maximum resistance of the combination occur?

A) P and Q

B) R and S

C) Q and S

D) S and P

Q.16 2 Ω, 4 Ω and 6 Ω resistors are connected in parallel with each other and also in parallel to a voltage supply of 10 V, the equivalent resistance and the potential drop across each resistance will be:

A) $\frac{12}{11}$ Ω and 10 V

B) 12 Ω and 10 V

C) $\frac{12}{11}$ Ω and 5 V

D) $\frac{11}{12}$ Ω and 10 V

Q.17 Three resistance 3 Ω, 6 Ω and 6 Ω are connected in parallel with each other, their effective resistance will be:

A) Less than 3 Ω

B) Equal to 3 Ω

C) Greater than 3 Ω but less than 6 Ω

D) Greater than 6 Ω

Q.18 What is the smallest total resistance which can be obtained using a 6 ohm and a 12 ohm resistor?

A) 2 Ω

B) 6 Ω

C) 4 Ω

D) 8 Ω

Q.19 When resistances are connected in parallel, the effective resistance will be:

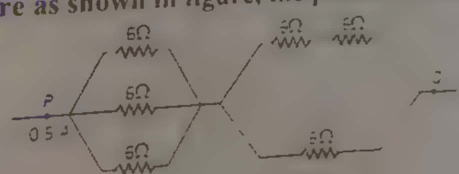
A) Product of the reciprocals of the individual resistances

B) Product of the individual resistances

C) Inverse of the sum of the reciprocals of the individual resistances

D) Sum of the individual resistances

Q.20 Resistances of 6 ohm each are connected in the manner shown in adjoining figure. With the current 0.5 ampere as shown in figure, the potential difference $V_P - V_Q$ is



A) 3.6 V

B) 6.0 V

C) 3.0 V

D) 7.2 V

Q.21 There are n similar conductors each of resistance R. The resultant resistance comes out to be x when connected in parallel. If they are connected in series, the resistance comes out to be

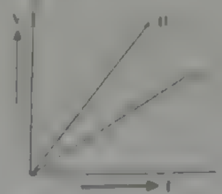
A) x/n^2

B) n^2x

C) x/n

D) nx

Q.22 V-I graphs for parallel and series combination of two metallic resistors are as shown in Fig. Which graph represents parallel combination?

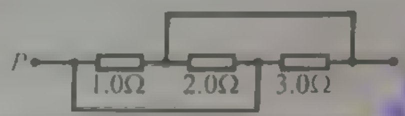


A) A
B) B
C) A and B both
D) Neither A and B

Q.23 We have 3 resistors each of the value 3 Ω. How these are connected to get resultant of 2 Ω?

A) All in series
B) All in parallel
C) 2 in series and 1 is parallel
D) 2 in parallel and 1 in series

Q.24 Three resistors are connected as shown in the diagram using connecting wires of negligible resistance



What is the approximate resistance between point P and Q?

A) 0.5 Ω
B) 2 Ω
C) 0.8 Ω
D) 2.2 Ω

Q.25 The diagram show the parallel combination of three resistors. The total resistance of the combination is 3 Ω.

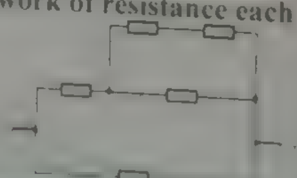
What is the resistance of resistor X?

A) 2 Ω
B) 6 Ω
C) 3 Ω
D) 12 Ω

Q.26 A student has 10 resistors, each of resistance r. The minimum resistance that can be obtained by him using these resistors is

A) 10 r
B) r/10
C) r/100
D) r/5

Q.27 The circuit diagram shows a network of resistance each of resistance R.



What is the effective resistance between point X and Y?

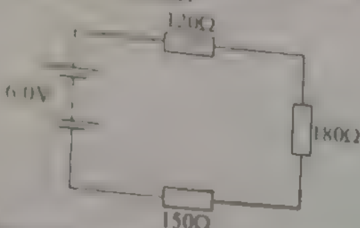
A) [illegible]
B) $\frac{5R}{8}$
C) $\frac{R}{2}$
D) $\frac{2R}{[illegible]}$

resistances are connected in series and then parallel the ratio of equivalent resistance from series to parallel is

C) n : 1

D) n^2 : 1

Three resistors are connected in series with a battery as shown in the diagram. The battery has negligible internal resistance.



What is the potential difference across the 180Ω resistor?

A) 1.6 V

B) 2.4 V

C) 3.6 V

D) 6.0 V

When the resistors are connected in series, then the physical quantity which remains constant

A) Current

B) Voltage

C) Capacitance

D) Inductance

In the given diagram, the current through the 4 ohm resistor will be:

A) 1 A

C) 1.5 A

D) 3 A

RESISTANCE AND RESISTIVITY

A wire of resistance R is cut into two equal parts, its resistance becomes R/2, what happens to resistivity:

A) Double

C) Same

D) One fourth

Q.33 A wire of resistance R is stretched four times its length uniformly. Its new resistance will be

A) 16 R

C) 4 R

D) $\frac{R}{16}$

The resistance of a wire is 1 Ω. Which of the following is new resistance if length of wire is doubled?

C) 4 Ω

Then resistance of Cu ___ and that of Ge ___

B) Increases, decreases

Q.36 Two copper wires X and Y have the same volume. Wire Y is four times as long as wire X.

What is the ratio $\frac{\text{resistance of wire Y}}{\text{resistance of wire X}}$?

A) 4 C) 16
B) 8 D) 64

POTENTIAL DIFFERENCE AND E.M.F

Q.37 By a cell a current of 0.9 A flows through 2 *ohm* resistor and 0.3 A through 7 *ohm* resistor. The internal resistance of the cell is

A) 0.5Ω C) 1.0Ω
B) 1.2Ω D) 2.0Ω

Q.38 The emf of the cell in the following circuit is 9.0 V. The reading on the high resistance voltmeter 7.5 V?

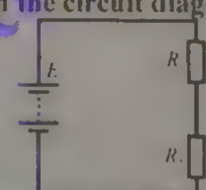
What is the current I?

A) 0.1 A C) 0.5 A
B) 0.6 A D) 2.0 A

Q.39 A cell of negligible resistance and e.m.f 2 V is connected across a series combination of 2,3 and 5 ohms. The p.d. across the 3 Ω resistor is

A) 0.6 V C) 2/3 V
B) 1/3 V D) 4/3 V

Q.40 A battery of e.m.f *E* and negligible internal resistance is connected to two resistors of resistance R_1 and R_2 as shown in the circuit diagram?



What is the potential difference across the resistors of resistance R_2?

A) $\frac{E(R_1+R_2)}{R_2}$ C) $\frac{E(R_1+R_2)}{R_1}$

B) $\frac{ER_1}{(R_1+R_2)}$ D) $\frac{ER_2}{(R_1+R_2)}$

POWER DISSIPATION IN RESISTORS

Q.41 You are given four bulbs of 25 W, 40 W, 50 W and 60 W. Which bulb has the least resistance?

A) 25 W C) 60 W
B) 50 W D) 40 W

Q.42 Two bulbs having the ratings 40 W, 220 V and 20 W, 110 V. The ratio of their resistance is

A) 1 : 2
B) 2 : 1
C) 1 : 1
D) 1 : 4

Q.43 Out of the two bulbs in a house, one glow brighter than the other. Which of the following has larger resistance?

A) The brighter bulb
B) Both have same resistance
C) The dim bulb
D) Brightness does not depend on resistance

Q.44 A total charge of 100 C flows through a 12 W light bulb in a time of 50s. What is the potential difference across the bulb during this time?

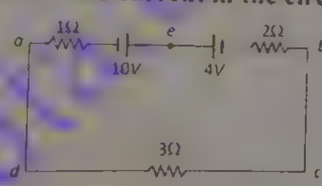
A) 0.12 V
B) 2.0 V
C) 6.0 V
D) 24 V

Q.45 When the internal resistance 'r' of a source is equal to the load resistance, 'R' the maximum power output is given by

A) $\frac{E}{r}$
B) $\frac{E^2}{4r}$
C) $\frac{E^2}{r}$
D) $\frac{E}{2R}$

KIRCHHOFF'S FIRST LAW AS CONSERVATION OF CHARGE

Q.46 The magnitude and direction of the current in the circuit shown will be

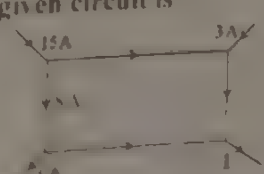


A) $\frac{7}{3}$ A from a to b through e
B) $\frac{7}{3}$ A from b to a through e
C) 1A from b to a through e
D) 1A from a to b through e

Q.47 Kirchhoff's two laws for electrical circuits are manifestations of the conservation

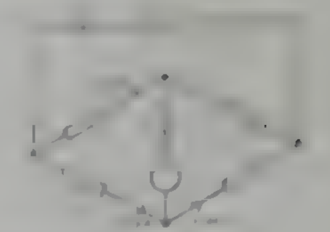
A) charge only
B) energy only
C) both energy and momentum
D) both charge and energy

Q.48 The value of current I in the given circuit is



C) 23 A
D) –3 A

[illegible] represents a circuit



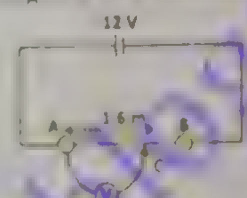
Some currents have been shown on the diagram.

What are the currents I_1 and I_2?

	I_1	I_2
A)	0.2 mA	10.8 mA
B)	0.2 mA	30.8 mA
C)	-0.2 mA	20.0 mA
D)	-0.2 mA	30.8 mA

POTENTIOMETER

Q.50 A 10Ω resistance wire AB of length 2 m is connected in a circuit as shown below



What is the reading on the voltmeter when the jockey is at point C?

A) 1.6V
B) 2.4V
C) 9.6V
D) 12V

ANSWER KEY

1	D	11	C	21	B	31	B	41	C
2	A	12	C	22	A	32	C	42	B
3	D	13	A	23	C	33	A	43	C
4	A	14	B	24	A	34	A	44	C
5	C	15	C	25	D	35	D	45	B
6	C	16	A	26	B	36	C	46	D
7	C	17	A	27	B	37	A	47	D
8	A	18	C	28	D	38	C	48	B
9	B	19	C	29	B	39	A	49	B
10	C	20	C	30	A	40	D	50	C

EXPLANATORY NOTES

In gases, charge carriers are

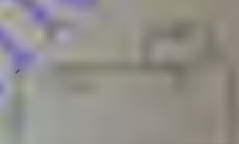
6 volt

for 6Ω

$= \frac{6}{6} = 1A \Rightarrow \boxed{I = 1A}$

Total current of circuit

For voltage



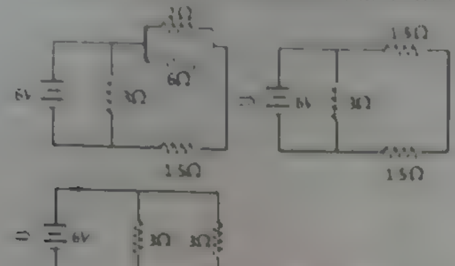
Q.8 According to Ohm's law $I \propto V$

If voltage is doubled then current will also be doubled so power will be four times.

$P \propto V^2$ also $P \propto I^2$

Q.9 $\frac{i_1}{i_2} = \frac{R_2}{R_1} = \frac{\ell_2}{\ell_1}\left(\frac{r_1}{r_2}\right)^2 = \frac{3}{4}\left(\frac{2}{3}\right)^2 = \frac{1}{3}$

Q.10 Given circuit can be redrawn as follows



$i = 6/1.5 = 4A$

Q.11 As the resistors are in series, the sum of potential differences across individual components is equal to the potential difference across the whole circuit. Potential difference across resistor $= 12 - 9 = 3V$

Q.12 Resistance of parallel group $= \frac{R}{2}$

∴ **Total equivalent resistance** $= 4 \times \frac{R}{2} = 2R$

Q.13 In stretching, $\frac{R_2}{R_1} = \left(\frac{r_1}{r_2}\right)^4 \Rightarrow \frac{R_2}{R} = \left(\frac{2}{1}\right)^4 \Rightarrow R_2 = 16R$

Q.14 $\frac{1}{Req} = \frac{1}{10} + \frac{1}{30} = \frac{30+10}{300} = \frac{40}{300}$

$Req = \frac{300}{40} = \frac{30}{4} = 7.5\Omega$

Q.15 $R_{eq_{Q \to S}} = 5\,\Omega$

Q.16 For parallel combination voltage remain same "10V".

$\frac{1}{R_{eq}} = \frac{1}{2} + \frac{1}{4} + \frac{1}{6} \Rightarrow R_{eq} = \frac{12}{11}\,\Omega$

Q.17 $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$

$\frac{1}{R_{eq}} = \frac{1}{3} + \frac{1}{6} + \frac{1}{6} \Rightarrow \frac{1}{R_{eq}} = \frac{2}{3}$

$R_{eq} = 1.5\Omega \Rightarrow R_{eq} < 3\Omega$

Or

In parallel combination of resistors, R_{eq} is always less than the smallest resistance of these.

Q.22 As for parallel combination equal resistance will be less. Thus slope of A is less, so it ... parallel combination of resistors.

Q.23

(A) ... in series ⇒ R = nR = 3(3) = 9Ω ⇒ incorrect

(B) All in parallel ⇒ R = $\frac{R}{n} = \frac{3}{3}$ = 1Ω ⇒ incorrect

(C) ... in series & 1 in parallel ⇒ 3 + 3 = 6Ω ⇒ $\frac{6\times3}{6+3} = \frac{18}{9}$ = 2Ω ⇒ correct

(D) 2 in parallel & 1 in series ⇒ $\frac{3}{2} + \frac{R}{n} = \frac{3}{2} + 3 = \frac{9}{2}$ Ω ⇒ incorrect

Q.24 $\frac{1}{R_{eq}} = \frac{1}{R} + \frac{1}{R} + \frac{1}{R} = \frac{1}{1} + \frac{1}{2} + \frac{1}{3}$

$\frac{1}{R_{eq}} = \frac{11}{6}$

... resistance = $R_{eq} = R_{min} = \frac{R}{n} = \frac{r}{10}$

Q.28 $\frac{R_s}{R_p} = \frac{nR}{\frac{R}{n}} = \frac{n^2}{1}$

Q.29 $V_1 = \frac{VR_1}{Req} = \frac{6\times180}{450} = 2.4\,V$

Q.30 In series combination of resistors current has only one path so it remains same.

Q.31 $I_2 = \left(\frac{R_2}{R_1+R_2}\right)I = \frac{8}{12}\times3 = 2\,A$

Q.32 Resistivity does not depend upon dimension (L, W) of wire. It only depends upon nature & temperature of wire.

Q.33 $R = \frac{\rho L}{A}$

$L' = 4L$

$A' = \frac{A}{4}$

$\boxed{R' = 16R}$

Q.34 $R = \frac{\rho L}{A} \Rightarrow \boxed{R \propto L}$

Q.35 Temperature coefficient of resistance $= \alpha^{+ve\ for\ Cu}_{-ve\ for\ Ge}$

$\Rightarrow \alpha = +ve$ for $Cu \Rightarrow T\uparrow \Rightarrow R\uparrow$ or $T\downarrow \Rightarrow R\downarrow$

& $\alpha = -ve$ for $Ge \Rightarrow T\uparrow \Rightarrow R\downarrow$ or $T\downarrow \Rightarrow R\uparrow$

So resistance of Cu decreases & that of Ge increases by cooling or decreasing temperature

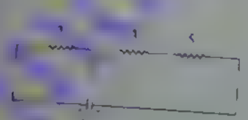
Q.36 $R = \frac{\rho L}{A} \Rightarrow R \propto \frac{L}{A}$

Q.37 $0.9(2+r) = 0.3(7+r) \Rightarrow 6 + 3r = 7 + r \Rightarrow r = 0.5\,\Omega$

Q.38 $V = IR$

$I = \frac{V}{R} = \frac{7.5}{15} = \frac{1}{2} = 0.5\,A$

Q.39



$V = \frac{3}{7+3}\times 2 = \frac{6}{10} = 0.6\,V$

Q.40 $V = \frac{R}{R+R}\,I$

Q.41 ... resistance of high power devices is smaller than the low power ones. The resistance of 60 watt bulb is smaller than 40 watt bulb and so on $P = \frac{V^2}{R}$ For a given voltage, $P \propto \frac{1}{R}$ So, 60 W bulb has the lowest resistance.

Q.42 $P = \frac{V^2}{R} \Rightarrow R = \frac{V^2}{P}$

$$\frac{R_1}{R_2} = \frac{V_1^2}{V_2^2} \times \frac{P_2}{P_1} = \left(\frac{V_1}{V_2}\right)^2 \times \frac{P_2}{P_1}$$

$$= \left(\frac{22\cancel{0}}{11\cancel{0}}\right)^2 \times \frac{2\cancel{0}}{4\cancel{0}} = 2:1$$

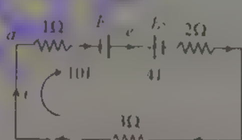
Q.43 Brightness $\propto \frac{1}{R}$

Q.44 $V = \frac{W}{q} = \frac{P \times t}{q} = \frac{12 \times 50}{100} = 6\,V$

Q.45 $P_{output} = \frac{E^2R}{(R-r)^2 + 4Rr} \Rightarrow R = r \Rightarrow P_{max} = \frac{E^2}{4r}$

Q.46 Since $E_1(10\,V) > E_2(4V)$

So current in the circuit will be clockwise.



Applying Kirchoff's voltage law

$-1 \times i + 10 - 4 - 2 \times i - 3i = 0 \Rightarrow i = 1A$ (a to b via c)

$\therefore$ Current $= \frac{V}{R} = \frac{10-4}{6} = 1.0$ ampere

Q.47 Kirchhoff's first law relates law of conservation of charge

Kirchhoff's second law relates law of conservation of Energy

Q.48 Current flowing towards the point = Current flowing away from the point

$7\,A + 3\,A + 3\,A = I$

$I = 13\,A$

Q.49 According 1^{st} Kirchoff's law

$I_1 + 10.6\,mA = 10.8mA$

$\boxed{I_1 = +0.2\,A}$

$I = 20.2\,mA + 10.6\,mA \Rightarrow \boxed{I_1 = 30.8\,mA}$

Q.50 Voltage across wire AB = 12V voltage across wire AC

$= \frac{\text{length of wire between AC}}{\text{length of wire between AB}} \times \text{voltage across AB} = \frac{1.6}{2.0} \times 12V = 9.6\,V$

PAST PAPER MCQ's (2008-2019)

2008

Q.1 A wire has resistance 100 Ohm at 0 °C and 200 Ohm at 100 °C. What is its temperature coefficient in K^{-1}?

A) −0.01 C) 0.01

B) [illegible] D) 1/273

Q.2 The algebraic sum of potential changes in a closed circuit is zero is Kirchhoff's rule.

A) First C) Third

B) Second D) Four

Q.3 The heat produced by a current I in the wire of resistance R during time interval t is

A) I^2/Rt C) $I^2/R/t$

B) I^2Rt D) IR^2t

2009

Q.4 The fractional change in resistance per Kelvin is known as:

A) Temperature coefficient of resistance

B) Thermal coefficient

C) Linear coefficient of expansion

D) Volumetric coefficient of expansion

Q.5 The energy supplied by the cell to the charge carriers is derived from the conversion of

A) Heat energy into Electrical energy

B) Chemical energy into Electrical energy

C) Solar energy into Electrical energy

D) Mechanical energy into Electrical energy

Q.6 The deviation of I-V graph from the straight line is due to:

A) Decrease in temperature and decrease in resistance

B) Increase in temperature and increase in resistance

C) Decrease in temperature and increase in resistance

D) Increase in temperature and decrease in resistance

2010

Q.7 The equivalent current which passes from a point at higher potential to a point at lower potential as if it represented a movement of positive charges is

A) Electronic current C) Magnetic lines

B) Electric current D) Conventional current

Q.8 Energy consumed by 60 watt bulb in 2 seconds is equal to

A) [illegible] C) 20 joules

B) [illegible] D) 0.02 joules

Q.9 The substances like germanium and silicon have

A) Negative temperature coefficient

B) Positive temperature coefficients

C) Both A and B

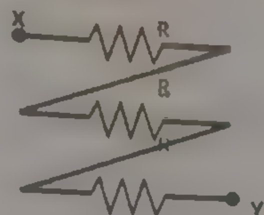
D) None of the above

2011

Q.10 If 2 A current passes through a resistor when connected to a certain battery. If the resistance is replaced by the double resistance, then the current will become

A) 2A
C) 6A
B) 4A
D) 1A

Q.11 Three resistors each having value 'R' are connected as shown in figure. What is the equivalence resistance between 'X' and 'Y'?



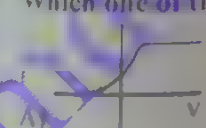
A) 3R
C) R/3
B) R
D) R^3

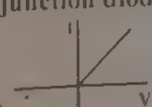
Q.12 Three resistors of resistance R_1, R_2 and R_3 are connected as shown in figure. Equivalence resistance is:

A) $R_1+R_2+R_3$
C) $\dfrac{R_1R_2+R_1R_3+R_2R_3}{R_2+R_3}$
B) $\dfrac{R_1+R_2+R_3}{R_2+R_3}$
D) $\dfrac{R_1R_2R_3}{R_2R_3}$

2012

Q.13 Which one of the following is I-V curve of a junction diode?

A) 

C) 

B) 

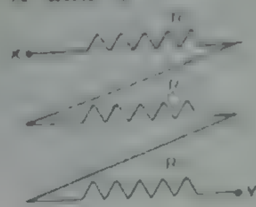
D) 

Q.14 Electric charge on an object is measured as 5 micro coulombs. How the value of this charge can be expressed in terms of base unit:

A) 5×10^{-3} ampere second
C) 5×10^{-6} ampere second
B) [illegible] ampere second
D) 5×10^{-2} ampere second

2013

Q.15 Three resistance each having value 'R' are connected as shown in figure. What is the equivalent resistance between 'X' and 'Y'?



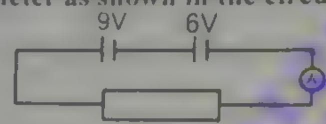
A) R
B) R/3
C) 3R
D) R

Q.16 12 volt battery is applied across 6Ω resistance to have a steady flow of current. What must be the required potential difference across the same resistance to have a steady current of one ampere?

A) 12V
B) 3.V
C) 1V
D) 6.V

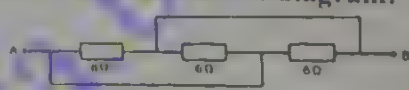
2014

Q.17 What is the reading of ammeter as shown in the circuit diagram?



A) 1A
B) 15A
C) 5A
D) 10A

Q.18 Three 6Ω resistors are connected as shown in the diagram.



What is the resistance between points 'A' and 'B'?

A) 0Ω
B) 18Ω
C) 4Ω
D) 2Ω

2015

Q.19 If a resister having resistance 'R' is cut into three equal parts, then equivalent of parallel combination is:

A) $\frac{9}{R}$
B) $\frac{3}{R}$
C) $\frac{R}{9}$
D) $\frac{R}{3}$

Q.20 Which combination of seven identical resistors each of 2Ω gives rise to the resultant 10 11Ω?

A) 5 parallel, 2 series
B) 4 parallel, 3 series
C) 3 parallel, 4 series
D) 2 parallel, 5 Series

... resistance of a piece of wire is 12Ω. It is bent to from an equilateral triangle. What ... equivalent resistance between any two corners of the triangles?

... Ω

C) 4.0 Ω

D) ... Ω

Q.22 Resistance between two opposite faces of square thin film of area 1mm² having thickness of 1μm If resistivity of material is 10⁻⁶Ω will be:

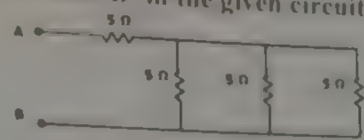
A) 1000 Ω

B) 100 Ω

C) 1Ω

D) 10 Ω

Q.23 Total resistance between 'A' and 'B' in the given circuit is



A) ... Ω

B) ... Ω

C) 0.33 Ω

D) 6.6 Ω

2017

Q.24 2×10^{6} electrons passing through a conductor in 1 ms. Find electric current flowing through conductor:

A) 32×10^{-9} A

B) $320 \times 10^{...}$ A

C) $3.2 \times 10^{...}$ A

D) 0.32×10^{-10} A

Q.25 A carbon resistor is connected to a battery of 50volt and 2ampere current is passing through it. If voltage is increased to 75volt, the current will become:

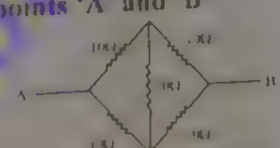
A) 3Amp

B) ...Amp

C) 4.5Amp

D) 6Amp

Q.26 If the resistance of each resistor is 10 ohm in the following figure then what will be the effective resistance between points 'A' and 'B'



A) ... ohms

B) ... ohms

C) 30 ohms

D) 10 ohms

... Test 2017

Q.27 When the current is neither drawn from a source nor given to it then:

A) ...

B) ...

C) ...

D) Both "B" & "C"

2018

Q.28 When potential difference is applied across the ends of uniform wire of length l and radius r, a current I flow in the wire. If same potential difference is applied to the ends of another wire of the same material but of length 2l and radius 2r, the current in the wire is

A) 1:4

B) 2I

C) ...

D) ...

[illegible] law is manifestation of

A) [illegible]
C) [illegible]
B) [illegible] of conservation of mass
D) Law of conservation of charge

[illegible] the rate at which energy is transferred by 220 V mains supply which [illegible] a current of 0.1 A to a LED?

A) 22 kW
C) 22 W
B) 2.2 kW
D) 2.2 W

[illegible] first law is manifestation of

A) [illegible]
C) Law of conservation of [illegible]
B) [illegible]
D) Law of conservation of [illegible]

A copper wire has length L and cross sectional area A. Its resistance is R. If we [illegible] the length and halved the diameter of wire then what will be the resistance of this wire

A) [illegible]
C) [illegible]
B) 3R
D) 4R

ANSWER KEY

1	C	11	A	21	D	31	D
2	B	12	C	22	[illegible]	32	C
3	B	13	B	23	D		
4	A	14	C	24	C		
5	B	15	C	25	A		
6	B	16	D	26	D		
7	D	17	C	27	A		
8	A	18	D	28	B		
9	A	19	C	29	D		
10	D	20	D	30	C		

EXPLANATORY NOTES

Q.1 $\alpha = \frac{[illegible]}{R_o t} = \frac{[illegible] - 100}{100 \times 100} = \frac{100}{100 \times 100} = 0.01$

Q.2 Statement of Kirchhoff's second rule.

Q.3 [illegible]ding to Joule's Law $H = I^2Rt$

Q.4 [illegible] of temperature co-efficient of resistance.

Q.5 The energy supplied by the cell to the charge carrier is derived from conversion [illegible] into electrical energy

Q.6 The deviation of I-V graph means, Temperature is not constant. So $\Delta R \propto \Delta t$

Q.7 Conventional current.

Q.8 $E = I^2 Rt = Pt$

$E = 60 \times 2\,s = 120\,J$

Q.9 The substances like germanium and silicon have negative temperature co-efficient of resistance.

Q.10

V = same

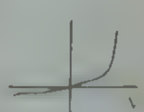
$I = \frac{V}{R} \quad \therefore I = 2A$

of $R' = 2R \quad I' = \frac{I}{2} = \frac{2}{2} = 1A$

Q.11 $R_{eq} = R + R + R = 3R$

Q.12

Q.13



Q.14

$Q = 5\mu c$

$Q = 5 \times 10^{-6}$ As

Q.15 $R_{eq} = nR = 3R$

Q.16

[illegible] $\qquad I = \frac{V}{R} = 2A$

[illegible]

Q 18 [illegible]

Q 19 [illegible]

$R_{eq} = \frac{R}{[illegible]}$

Q 20

[illegible]

$R' = nR$ [illegible] 10Ω

5 in series.

Remaing in parallel Combination

Q 21

$R_{eq} = \left(\frac{n-1}{n^2}\right)R, \; n = 3, R = 12$

[illegible] $\frac{3-1}{9} \times 12 = \frac{2}{9} \times 12 = 2.7\Omega$

Q 22

Q 23 Three '5' ohms resistances are in parallel

$R = \frac{R}{n} = \frac{5}{3}$

$R_{AB} = 5 + \frac{5}{3} = \frac{15+5}{3} = \frac{20}{3} = 6.6\Omega$

Q 24 $I = \frac{Q}{t} = \frac{ne}{t} = \frac{2\times 10^{[illegible]} \times 1.6 \times 10^{-19}}{10^{[illegible]}} = 3.2 \times 10^{-10} A$

Q 25

[illegible]

Q 26

[illegible]

$R_{eq} = \frac{R}{n} = \frac{20}{2}$ [illegible]

[illegible]

Q.28

[illegible]

$$= 2I$$

Q.29 Charge entering the system is equal to charge leaving the system.

Q.30

$$R = \frac{V}{I} = \frac{220}{0.1} = 2200\Omega$$

$$P = \frac{V^2}{R} = \frac{(220)^2}{2200} = 22W$$

Q.31 Charge entering the system is equal to charge leaving the system

Q.32

$$R = \frac{\rho l}{A} = \frac{\rho l}{\pi r^2} = \frac{\rho l}{\pi \frac{D^2}{4}}$$

$$R = \frac{4\rho l}{\pi D^2}$$

$$R' = \frac{4\rho l \cdot 2}{\pi\left(\frac{D}{2}\right)^2}$$

$$= \frac{4\rho l}{2\pi D^2/4} = 2\left(\frac{4\rho l}{\pi D^2}\right) = 2R$$

TOPIC-11 ELECTROMAGNETISM

PRACTICE EXERCISE

TOPIC-WISE MCQ's

MAGNETIC FIELD

Q.1 Current I is flowing in a long conducting wire, the magnetic induction at a distance r from it is 0.4 tesla, then its value at double the distance will be

A) 1.6 tesla C) 0.2 tesla
B) 0.8 tesla D) 0.1 tesla

Q.2 The magnetic field produced due to the current in a straight wire is proportional to the.

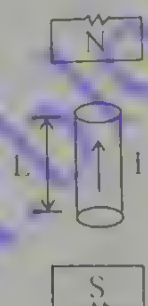
A) Electric current C) Conducting material
B) Length of the wire D) Diameter of the wire

Q.3 The magnetic field due to the electric current in a conducting straight wire is:

A) Towards the centre of the conducting wire
B) Circular around the conducting wire
C) In the direction of the electric current
D) In the direction opposite to the electric current

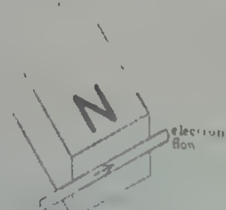
FORCE ON CURRENT CARRYING CONDUCTOR IN UNIFORM MAGNETIC FIELD

Q.4 A wire carrying current (I) is place in a region of magnetic field as shown in figure direction of force is



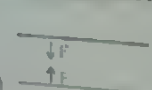
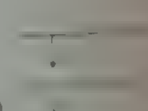
A) into paper C) towards right
B) out of paper D) no force is acting

Q.5 The figure shows the motion of electrons in a wire that is near the N pole of a magnet. The wire will be pushed:

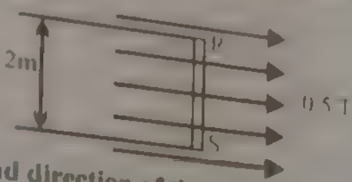


A) Upwards C) Downward
B) Away from the magnet D) Toward the magnet

Q.6 Two wires carry currents in same direction which is correct

A) 
B) 
C) 
D) 

7. The diagram shows a current carrying conductor RS of length 2m placed perpendicular in a magnetic field of flux density 0.5 tesla. The resulting force on the conductor is 1 N acting into the plane of paper



What is the magnitude and direction of the current?

A) [illegible] A from R to S
B) [illegible] A from R to S
C) 1 A from S to R
D) 2 A form S to R

Q.8 **Two parallel wires carrying currents in the opposite directions**

A) Repel each other
B) Have no effect upon each other
C) Attract each other
D) They cancel out their individual magnetic fields

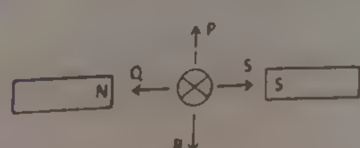
Q.9 **The direction of the magnetic lines of force depends upon:**

A) Nature of the material of the conducting wire
B) Area of the conducting wire
C) Amount of the current
D) Direction of the current

Q.10 **The direction at a point on the magnetic lines of force can be taken along:**

A) Normal at that point
B) The tangent at that point
C) Axis of the magnetic line of force at that point
D) Can't be taken

Q.11 **The figure given below shows a current- carrying conductor placed between two magnets. Which of the given arrows correctly indicates the direction of the force acting on the conductor?**



A) R
B) P
C) Q
D) S

Q.12 **The direction of the magnetic lines of force can be found by using:**

A) Right hand rule
B) [illegible]'s law
C) Left hand rule
D) Faraday's law

Q.13 **The Relationship between tesla(T) and smaller unit gauss(G) of magnetic induction is given by**

A) [illegible]
B) 1T = 10[illegible] G
C) $1T = 10^{-4}$ G
D) 1T = 10[illegible] G

Q.14 A current carrying conductor is placed in a uniform magnetic field Parallel to it. The magnetic force experienced by the conductor is

A) $F = BIL$

B) $F = \frac{BL \sin\theta}{I}$

C) $F = \frac{I}{BL}\sin\theta$

D) $F = 0$

Q.15 A conductor of length 1m and carrying current of 1 A is placed at an angle of 45° to a magnetic field of 1 gauss. The force acting on the conductor is

A) Zero

B) $\frac{1}{\sqrt{2}} \times 10^{-4}$ N

C) $\frac{1}{\sqrt{2}}$ N

D) 5×10^{-4} N

Q.16 A uniform magnetic field is represented by a set of lines of force which are

A) Parallel

B) Divergent

C) Convergent

D) None of these

Q.17 Weber ampere per metre is equal to

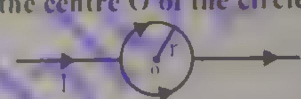
A) Joule

B) Watt

C) Newton

D) Henry

Q.18 A straight conductor carries a current I, is split into a circular loop of radius r as shown in fig. The magnetic field at the centre O of the circle is



A) $\frac{\mu_o I}{2r}$

B) $\frac{\mu_o I}{\pi r}$

C) $\frac{\mu_o I}{2\pi r}$

D) Zero

Q.19 When a current carrying conductor is placed in a magnetic field. It moves from a region of

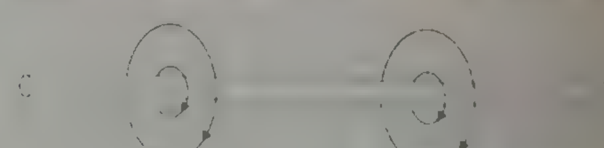
A) Stronger to weak field

B) Strong to weak if current is large

C) Weak to strong field

D) Weak to strong if current is large

Q.20 Diagram shows the magnetic field around a conductor. In which direction is the current flowing?



A) From right to left

B) From left to right

C) Can be either of above

D) Data incomplete

Q.21 Two conductors shown below will be

A) Repel

B) Attract

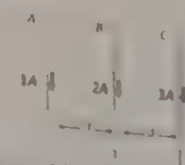
C) Neither repel nor attract

D) Data insufficient

A wire of length 2 m carries a current of 10 A. what is the force acting on it when it is placed at an angle of 45° to the uniform magnetic field of 0.15 T?

A) ...2 N
B) 3.2 N
C) 2.5 N
D) $\frac{3}{\sqrt{2}}$ N

Q.23 Three long straight wires A, B and C are carrying current as shown in figure. Then the resultant force on B is directed:



A) perpendicular to the plane of paper and inward
B) towards A
C) perpendicular to the plane of paper and outward
D) towards C

Q.24 A one metre long wire is lying at right angles to the magnetic field. A force of 1 N is acting on it in a magnetic field of 0.98 tesla. The current flowing in it will be
A) 100 A
B) zero
C) 10 A
D) 1 A

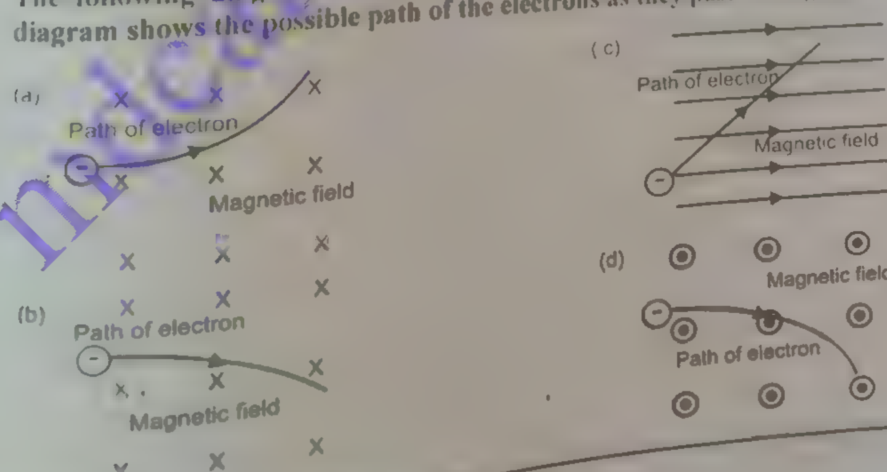
Q.25 The force on the conductor will be

A) Downward
B) From left to right
C) From right to left
D) Upward

FORCE ON A MOVING CHARGE IN MAGNETIC FIELD

Q.26 A proton is moving northward in a magnetic field directed vertically upward. The electron will be deflected:
A) Eastward
B) Westward
C) Vertically upward
D) Remain undeflected

Q.27 The following diagrams shows an electron passing through a magnetic field. Which diagram shows the possible path of the electrons as they pass through the field?



Q.28 In the formula $F = q(v \times B)$

A) F must be perpendicular to v but not necessarily to B

B) v must be perpendicular to B but not necessarily to F

C) F must be perpendicular to both v and B

D) All three vectors must be mutually perpendicular

Q.29 A proton and an electron both moving with the same velocity v enter into a region of magnetic field directed perpendicular to the velocity of the particles. They will now move in circular orbits such that

A) Their time periods will be same

B) The time period for electron will be higher

C) The time period for proton will be higher

D) Their orbital raddi will be same

Q.30 A positively charged particle moving due east enters a region of uniform magnetic field directed vertically upwards. The particle will

A) Continue to move due east

B) Move in a circular orbit with its speed unchanged

C) Move in a circular orbit with its speed increases

D) Get deflected vertically upwards

Q.31 A strong magnetic field is applied to a stationary electron, then

A) Electron move in the direction of field
B) Electron move opposite to field
C) Electron start spinning
D) Electron remain stationary

Q.32 The magnitude of force on a moving charge is zero then angle between the velocity of the charge carrier and magnetic field is

A) 0°
B) 90°
C) 45°
D) 120°

Q.33 An electron enters in a uniform magnetic field making an angle 60° with field. The shape of its trajectory in magnetic field is

A) circle
B) parabola
C) straight line
D) helix

Q.34 The radius of curvature of the path of the charged particle in a uniform magnetic field is directly proportional to

A) the energy of the particle
B) the momentum of the particle
C) the intensity of the field
D) the charge on the particle

Q.35 Which of the following in motion cannot be deflected by magnetic field?

A) Electron
B) Neutron
C) Proton
D) Sodium ion

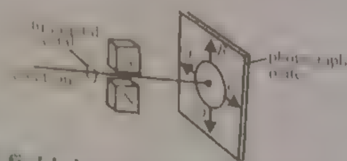
Q.36 A charged particle enters at 30° to the magnetic field. Its path becomes

A) Helical
B) Elliptical
C) Circular
D) Straight line

Q.37 When a charged particle is projected perpendicularly in a magnetic field its trajectory

A) Hyperbola
B) Helix
C) Parabola
D) Circular

Q.38 **G.P Thomson's early experiments on the diffraction of the electrons by crystals were criticized on the ground that the beams affecting the photographic plate might be X-rays. He proved that this was not so by placing bar magnets on each side of the beam as shown in the diagram.**



How would the magnetic field due to magnetic affect the diffraction rings?

A) The rings would be deflected in the direction A
B) The rings would be deflected in the direction C
C) The rings would be deflected in the direction B
D) The rings would be deflected in the direction D

Q.39 **When a charged particle moves through a magnetic field, it suffers a change in**

A) Direction
B) Speed
C) Energy
D) No change

Q.40 **Magnetic field is caused by**

A) Stationary charge
B) A moving positive charge only
C) A moving negative charge only
D) Moving positive and negative charges both

Q.41 **A charged particle moves through a magnetic field in a direction perpendicular to it. Which of the following remain unchanged for the particle?**

A) Velocity
B) Acceleration
C) Speed
D) Direction

MOTION OF CHARGE PARTICLE IN UNIFORM ELECTRIC AND MAGNETIC FIELD

Q.42 **If a particle is moving in a region of both electric & magnetic fields then the total force acting on it is.**

A) sum of electric & magnetic force
B) no force will act on it
C) difference of electric & magnetic force
D) none of above

Q.43 **A homogeneous electric field $\vec{E}$ and a uniform magnetic field $\vec{B}$ are pointing in the same direction. A proton is projected with its velocity parallel to $\vec{E}$. It will**

A) Go on moving in the same direction with increasing velocity
B) Go on moving in the same direction with constant velocity
C) Turn to its right
D) Turn to its left

On FOR AN ELECTRON

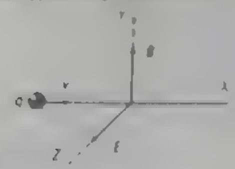
Q.44 **An α particle, a deuteron and a proton are moving with same momentum in a uniform magnetic field. The ratio of their speeds will be**

A) 1:2:4
B) 4:2:1
C) 1:1:1
D) 2:2:4

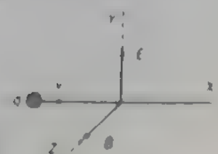
Q.45 **The unit of E is $N\ C^{-1}$ and that of B is $N\ A^{-1}\ m^{-1}$ the unit of $\frac{E}{B}$ is**

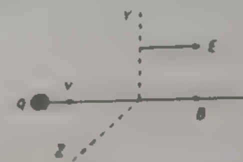
C) m s
D) $m^{-1} s^{-1}$

Q.46 Particle of charge q and mass m is moving along the x-axis with a velocity v and enters a region of electric field E and magnetic field B for which figure the net force on the charge may be zero

A) 

C) 

B) 

D) 

Q.47 The radius of curvature of the path of a charged particle moving in a static uniform magnetic field is
A) Directly proportional to the magnitude of the charge on the particle
B) Directly proportional to the magnitude of the linear momentum of the particle
C) Directly proportional to the kinetic energy of the particle
D) Inversely proportional to the magnitude of the magnetic field

Q.48 An electron enters a region where the electric field $\vec{E}$ is perpendicular to the magnetic field $\vec{B}$. It will suffer no deflection if ____________
A) $E = Bev$
B) $B = eE/v$
C) $E = Bv$
D) $E = BeV^2$

Q.49 A proton (mass m and charge +e) and an α - particle (mass 4m and charge +2e) are projected with the same kinetic energy at right angles to the uniform magnetic field. Which one of the following statements will be true
A) the α - particle and the proton will be bent in a circular path with the same radius
B) the α - particle will be bent in a circular path with a small radius that for the proton
C) α - particle and the proton will go through the field in a straight line
D) the radius of the path of the α - particle will be greater than that of the proton

Q.50 One proton beam enters a magnetic field of 10^{-4}T normally, Specific charge = 10^{11}C/kg. velocity = 10^7m/s. What is the radius of the circle described by it
A) 0.1 m
B) 1 m
C) 10 m
D) None of these

ANSWER KEY

1	C	11	A	21	B	31	D	41	C
2	A	12	A	22	D	32	A	42	A
3	B	13	D	23	D	33	D	43	A
4	D	14	D	24	D	34	B	44	A
5	A	15	B	25	D	35	B	45	B
6	C	16	A	26	A	36	A	46	B
7	C	17	C	27	B	37	D	47	B
8	A	18	D	28	C	38	A	48	C
9	D	19	A	29	B	39	A	49	A
10	B	20	B	30	B	40	D	50	B

EXPLANATORY NOTES

Q.1 $B = \frac{\mu_0 I}{2\pi r}$ (For straight wire)

$B \propto \frac{1}{r}$

So, when distance becomes double "B" will reduce to half.

Q.2 $B = \frac{\mu_0 I}{2\pi r}$

$B \propto I$

Q.3 Magnetic field is circular in case of a straight wire.

Q.4 $F = ILB\sin\theta$ (where $\theta = 180°$)

$F = 0$

Q.5 Right hand palm rule

Q.6 When direction of current in two parallel wires are same then force of attraction will produce due to weak magnetic field between wires.

Q.7 According to right hand rule direction of current is from S to R

$F = ILB \rightarrow I = \frac{F}{LB} = \frac{1}{2 \times 0.5} = 1\,A$

Q.8 Two parallel wires having current in opposite direction always repel each other because magnetic field between the wires become stronger.

Q.9 Direction of magnetic field depends upon direction of current according to right hand rule

Q.10 Direction of magnetic field is along the tangent on a curve.

Q.11 According to R.H.R, arrow R correctly indicates the direction of force acting on the conductor

Q.12 Direction of magnetic lines of forces can be found by right hand rule.

Q.13 $1T = 10^4\,G$

Q.14 $F = ILB\sin\theta \quad \theta = 0° \Rightarrow F = 0$

Q.15 $1T = 10^4\,G$

$1G = 10^{-4}\,T$

$F = ILB\sin\theta = (1)(1)(10^{-4})\sin 45°$

$\boxed{F = \frac{1}{\sqrt{2}} \times 10^{-4}\,N}$

Q.16 Parallel lines of forces produce uniform field.

Q.17 $\frac{\text{weber} \times \text{ampere}}{\text{meter}} = \frac{NmA^{-1}.A}{m} = N$

Q.18 It is a case similar to that two wires have same current in same direction having field zero at the midway between them

Q.19 Current carrying conductor will move from stronger to weaker magnetic field.

Q.20 According to R.H.R, curling fingers represent path of magnetic field and thumb indicates direction of current.

Q.21 Both the conductors are marked with dots. The currents are both flowing toward the observer (i.e in same direction).

Q.22 $F = ILB\sin\theta = 10\times 2\times 0.15\sin 45^\circ = \frac{3}{\sqrt{2}}$ N

Q.23 $F \propto I_1 I_2$, so force on B due to C will be greater than that due A. Hence net force on B acts towards C.

Q.24 $F = IBL \Rightarrow I = \frac{F}{BL} = \frac{1}{0.98\times 1} = 1.02A = 1A$

Q.25 By using RHR.

Q.26 $\vec{F}_{m} = -e\vec{v}\times\vec{B} = -e\left(v\hat{j}\right)\times B\left(-\hat{k}\right) = evB\hat{i}$

i.e direction of force is eastward

Q.27 Application of right hand palm rule or Fleming's left hand rule.

Q.28 In vector product, all three vectors are mutually perpendicular.

Q.29 We know that time period $T = \frac{2\pi m}{qB}$ i.e. $T \propto m$ (Since q and B are same)

Mass of proton > Mass of electron

Time period of proton > Time period of electron.

Q.30 According to $\vec{F} = q\left(\vec{v}\times\vec{B}\right)$

In perpendicular magnetic field the path of a charged particle is a circle, and the magnetic field does not cause any change in speed and energy.

Q.31 $F = qvB\sin\theta$

$F = 0 \quad \because \theta = 0$

So, electron remain stationary

Q.32 $F = qvB\sin\theta \Rightarrow F = 0$ when $\theta = 0^\circ$

Q.33 If angle equal to 90°, then trajectory will be circle and $90^\circ > \theta > 0^\circ$ trajectory will be helix

Q.34 $r = \frac{p}{qB} \rightarrow r \propto p$

Q.35 Only charge particle can deflect in a magnetic field.

Q.36 When $\theta = 0^\circ$ path is straight

When $\theta = 90^\circ$ path is circular

When $0^\circ < \theta < 90^\circ$ path is helical

Q.37 When $\theta = 90^\circ$ path is circular

Q.38 According to right hand rule ring will deflect towards "A".

Q.39 Magnetic field is deflecting field which only change the direction

Q.40 Moving charge (may +ve or -ve) produce magnetic field

Q.41 Magnetic field does no work so, K.E. of charge remain same, so speed also remain same

Q.42 $F_t = F_e + F_b = qE + qvB$

Q.43 Here magnetic force is zero, but the velocity increases due to electric force

Q.44 $P = mv$

$P = \text{constant}$

$v \propto \frac{1}{m}$

Charge on proton, ductron and α - particles is +e, +e and +2e respectively

$m_{\alpha} : m_{duet} : m_{proton} = 4:2:1$

$v_{\alpha} : v_{duet} : v_{proton} = 1:2:4$

Q.45 $\frac{E}{B} = \frac{NC^{-1}}{NA^{-1}m^{-1}} = \frac{C^{-1}}{A^{-1}m^{-1}} = \frac{A^{-1}s^{-1}}{A^{-1}m^{-1}} = ms^{-1}$

Q.46 The charge will not experience any force if

$F_e = F_m$ This condition is satisfied in option only

Q.47 $r = \frac{p}{qB} \rightarrow r \propto p$

Q.48 $qvB = qE$

$E = Bv$

Q.49 $r = \frac{\sqrt{2mK}}{qB}$ i.e. $r \propto \frac{\sqrt{m}}{q}$ Here kinetic energy K and B are same

$\therefore \frac{r_p}{r_\alpha} = \sqrt{\frac{m_p}{m_\alpha}} \cdot \frac{q_\alpha}{q_p} = \sqrt{\frac{m_1}{4m_p}} \cdot \frac{2q_1}{q_\alpha} = 1 \Rightarrow r_\alpha = r$

Q.50 $r = \frac{mv}{qB} = \frac{10^7}{10^{11} \times 10^{-4}} = 1m \left(\because \frac{q}{m} = 10^{11} C/kg\right)$

PAST PAPER MCQ's (2008-2019)

2008

Q.1 **An electric charge in uniform motion produces:**

A) An electric field
B) A magnetic field
C) Both magnetic and electric fields
D) Neither magnetic nor electric fields

2009

Q.2 **A charge of two micro coulombs (2 μC) moves with velocity of two meter per second (2 m/sec) in the direction of two Tesla magnetic field. The force that will act on it will:**

A) 2N
B) Zero
C) 8N
D) 4N

Q.3 **Force experienced by a moving change in a magnetic field is:**

A) $F = BA \cos\theta$
B) $F = \mu_o NI$
C) $F = q(v \times B)$
D) $F = I(L \times B)$

2010

Q.4 **Force on a current carrying conductor in a uniform magnetic field is**

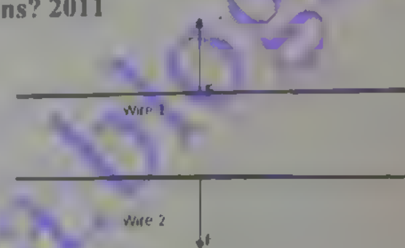
A) $F = NIA \cos \alpha$
B) $F = \mu nI$
C) $F = ILB \sin \alpha$
D) $F = ILA \cos \alpha$

Q.5 **Which one of the following relations is correct?**

A) $1\ wb\ m^{-2} = N\ m^{-1}\ A^{-1}$
B) $1\ Tesla = 10^4$ Gausses
C) $1\ wb\ m^{-2} = 1$ Tesla
D) All of these

2011

Q.6 **Two long parallel wires Wire 1 and Wire 2 repel each other as shown in the figure. What could be the reasons? 2011**



A) Both carry current in same direction
B) Both carry current in opposite direction
C) Wire 1 has current, but Wire 2 has no current
D) Wire 2 has current, Wire 1 has no current

2012

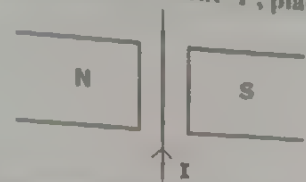
Q.7 **Two long straight parallel wires held vertically, have equal but opposite currents shown in the figure.**

Which of the following effect will be observed?

A) Magnetic field at 'X' is stronger than that at 'Y' and 'Z'
B) Magnetic field at 'X', and 'Z' are same
C) Magnetic field at 'X' is weaker than that at Z
D) Magnetic field at 'X' is weaker than that at out, stronger than that at Z

[illegible]

Q.8 The diagram shows a wire, carrying a current 'I', placed between the poles of a magnet:



In which direction does the force on the wire act?

A) Towards the 'N' pole of the magnet
B) Downwards
C) Upwards
D) Towards the 'S' pole of the magnet

Q.9 A long straight current carrying conductor has current direction from bottom to top when held vertically. What will be the direction of magnetic field lines when observed from below the conductor?

A) Clockwise
B) Vertically upward
C) Anticlockwise
D) Vertically downward

2014

Q.10 Due to current in straight conductor the distance between magnetic field lines. 2014

A) Increases away from conductor
B) Increases towards conductor
C) Decreases away from conductor
D) Decreases and then increases towards conductor

2015

Q.11 If 'A' is fundamental dimension of ampere then the dimension of magnetic field strength is:

A) $[MT^{-2}A^{-2}]$
B) $[MT^{-2}A^{-1}]$
C) $[MT^{-2}L^{2}A^{-1}]$
D) $[MT^{-2}L^{-2}A^{-2}]$

Q.12 Force on current carrying conductor per unit length is given by

A) $IL\sin\theta$
B) ILB
C) IL
D) $IB\sin\theta$

2016

Q.13 'F' is maximum force acting on a conductor. Now if we change the direction of conductor by making an angle of 45° with magnetic field then the force becomes

A) $\frac{F}{2}$
B) 2F
C) $\frac{F}{\sqrt{2}}$
D) $\sqrt{2}F$

Q.14 If we doubled all the parameters of the force acting on current carrying conductor and $\theta = 90°$ then magnetic force becomes

A) [illegible]
B) Double
C) Eight times
D) Four times

Q.15 The force acting on current carrying conductor will be maximum if the angle between magnetic field and conductor is

A) [illegible]
B) [illegible]
C) 90°
D) 60°

2016

Q.16 If the value of magnetic flux is 10Wb, when magnetic lines of force containing magnetic field strength of 1Tesla passing through unit area of $10m^2$ then the angle between magnetic field and unit area is

A) 180° C) 90°

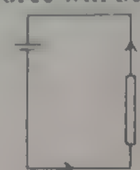
B) 360° D) 45°

Q.17 A charge is projected with velocity of 10m/s in a magnetic field of 10T at angle of [illegible], force of 2.78×10^{-17} N is exerted on the charge then value of charge will be.

A) 1.60×10^{-19} C C) 4.80×10^{-19} C

B) 2.70×10^{-19} C D) 3.20×10^{-19} C

Q.18 Electric current is flowing through a straight conductor as shown in figure given below. The direction of magnetic lines of force will be



A) Anticlockwise C) From Bottom to Top

B) Clockwise D) From Top to Bottom

Retake 2017

Q.19 A conductor of length 1 m carrying current of 1 A is placed parallel to a magnetic field of 1 guess. The magnetic force acting on the conductor is:

A) Zero C) 10^{-4} newton

B) 1 newton D) 1 dyne

2018

Q.20 Two long, parallel conductors which are free to move are arranged 1.0 cm apart. A steady current of 20 A flows in each of the conductor in the same direction. The conductors

A) remain stationary C) move away from each other

B) move towards each other D) move at right angles to each other

Q.21 A neutron having mass equal to a proton ($m_p = 1.6 \times 10^{-27}$ kg) is moving in a magnetic field of intensity 1.20×10^{-3} T with a speed of 2.0×10^{7} ms^{-1} what is the Maximum force experienced by the neutron.

A) $3.84 \times 10^{[illegible]}$ N C) 3.84×10^{-12}N

B) 0 N D) 38.4×10^{-15}N

Q.22 e/m of an electron is given by the relationship,

A) $e/m = 2(V/B^2r^2)$ C) $e/m = Vr/B$

B) $e/m = (V/Br)$ D) $e/m = VB.r$

23. If a conductor of length 7 m is placed in a magnetic field strength 0.3 T carrying current 1A. parallel to the field. What will be the force acting on it due to this magnetic field?

A) [illegible]
B) [illegible]
C) 3.1 N
D) 7 N

24. The horizontal component of earth magnetic flux density is 1.8×10^{-6} T. The current in a horizontal cable is 160A. Calculate the maximum force per unit length?

A) 2.88×10^{-4} N/m
B) 2.88×10^{-8} N/m
C) 2.88×10^{-2} N/m
D) 2.88×10^{-6} N/m

ANSWER KEY

1	C	11	B	21	B
2	B	12	D	22	A
3	C	13	C	23	B
4	C	14	C	24	A
5	D	15	C		
6	B	16	A		
7	A	17	D		
8	B	18	B		
9	A	19	A		
10	A	20	B		

EXPLANATORY NOTES

Q.1 When an electronic charge is at rest, it produces only electric field but when electric charge is in uniform motion, it produces both magnetic and electric field.

Q.2

$F = qvbB\sin\theta \quad \therefore \theta = 0^\circ$

$F = qvB\sin 0^\circ = 0$

Q.3 Force on moving charge is $\vec{F} = q(\vec{V} \times \vec{B})$

Q.4 $F = ILB\sin\alpha$

Q.5 All relations are correct.

Q.6 Unlike currents in wires repell each other.

Q.7 At "X" two fields reinforce each other by R.H.R. So magnetic field at "X" is stronger than that at "Y" and "Z".

Q.8 By R.H.R the force acting on current carrying wire is into the page (i.e downwards)

Q.9 By R.H.R the direction of magnetic field lines in a current carrying wire is clock-wise.

Q.10 $B \propto \frac{I}{r}$ Near the conductor, magnetic field lines are closer while away from conductor magnetic field lines are wider.

Q.11 $B = \frac{F}{IL}$

$$[B] = \frac{[MLT^{-2}]}{[AL]} = [MT^{-2}A^{-1}]$$

Q.12 $F = ILB\,\text{Sin}\,\theta$

$$\frac{F}{L} = IB\,\text{Sin}\,\theta$$

Q.13 $F' = ILB\,\text{Sin}\,\theta = F\,\text{Sin}\,\theta$

$$F' = F\,\text{Sin}\,45^\circ = \frac{F}{\sqrt{2}}$$

Q.14 $F = ILB\,\text{Sin}\,\theta = ILB \quad \because \theta = 90^\circ$

$F' = (2I)(2L)(2B) = 8(ILB) = 8F$

Q.15 $F = ILB\,\text{Sin}\,\theta = ILB \quad \because \theta = 90^\circ$

Q.16 $\phi = BA\cos\theta$

$$\theta = \cos^{-1}\left(\frac{\phi}{BA}\right) = \cos^{-1}\left(\frac{10}{1\times10}\right) = \cos^{-1}(1) = 0^\circ \text{ or } 180^\circ$$

Q.17

$F = qvB\sin\theta$

$$q = \frac{F}{vB\sin\theta} = \frac{2.78\times10^{-17}}{10\times10\times\sin 60}$$

$$= \frac{2.78\times10^{-17}\times2}{\sqrt{3}} = \frac{5.56\times10^{-19}}{1.73} = 3.2\times10^{-19}\,C$$

Q.18 Use Conventional Current and R.H.R

Q.19

$F = ILB\sin\theta$

$\theta = 0^{\circ}$

$F = 0$

Q.20 When current flows in same direction in the wires, wires attract each other.

Q.21 $F = qvB\text{Sin}\,\theta \Rightarrow q = 0$ for neutron $\Rightarrow F = 0$

Q.22 $\dfrac{e}{m} = \dfrac{2V}{B^2 r^2}$

Q.23 $F = ILB\text{Sin}\,\theta$

For Parallel direction $\theta = 0°$

$F = 0$

Q.24 $F = ILB\sin\theta = ILB \quad \because \theta = 90 \Rightarrow \dfrac{F}{L} = IB = 160 \times 1.8 \times 10^{-6} = 2.88 \times 10^{-4}\ \text{Nm}^{-1}$

TOPIC-12 ELECTROMAGNETIC INDUCTION

PRACTICE EXERCISE

TOPIC-WISE MCQ's

MAGNETIC FLUX

Q.1 The magnetic induction B is also called the

A) flux
B) density
C) flux density
D) tesla

Q.2 The unit of magnetic flux density is

A) Wb m^{-2}
B) N A^{-1} m^{-1}
C) tesla
D) all of these

Q.3 A straight copper wire is moved in a uniform magnetic field such that it cuts the magnetic lines of force. Then

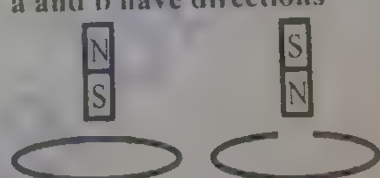
A) emf will not be induced
B) emf will be induced
C) sometimes emf will be induced and sometimes not
D) nothing can be predicted

Q.4 At what angle the magnetic flux will be half of its maximum value

A) 30°
B) 60°
C) 90°
D) 45°

FARADAY'S LAW AND LENZ'S LAW

Q.5 In a closed ring (A) and in an open ring (B) magnets are falling along the axis of the ring. The current generated in a and b have directions



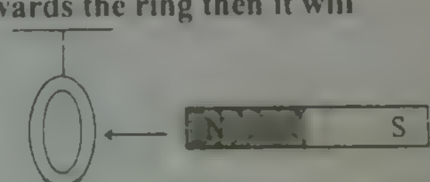
(a) (b)

A) Clockwise, Zero
B) Anticlockwise, zero
C) Anticlockwise, clockwise
D) Zero, zero

Q.6 The direction of induced current in a coil or circuit is such that it opposes every cause its production. This law is given by

A) Faraday
B) Kirchhoff
C) Lenz
D) Ampere

Q.7 A metallic circular ring is suspended by a string and is kept in a vertical plane. When magnet is approached towards the ring then it will



A) Remain stationary
B) Get displaced away from the magnet
C) Get displaced towards the magnet
D) Nothing can be said

In the equation [illegible] $\frac{\Delta\Phi}{\Delta t}$ the negative sign indicates that

A) The [illegible] current opposes its cause

B) The [illegible] in accordance with the Lenz's Law

C) [illegible] opposes the change which produces it.

D) All of the above

Q.9 The e.m.f. induced in a coil is .... the rate of change in flux linkages.

A) [illegible] proportional to

B) [illegible] proportional to

C) Independent of

D) None of the above

Q.10 A coil having 500 square loops each of side 10 cm is placed normal to a magnetic induction which increases at the rate of 1.0 tesla/second. The induced e.m.f. in volts is

A) 5

B) [illegible]

C) 1

D) 0.5

Q.11 In a circuit with a coil of resistance 2 ohms, the magnetic flux changes from 2.0 Wb to 10.0 Wb in 0.2 second. The charge that flows in the coil during this time is

A) 8.0 coulomb

B) 4.0 coulomb

C) 1.0 coulomb

D) 0.8 coulomb

INDUCED E.M.F AND FACTORS

Q.12 When magnet is in motion relative to a coil, an induced e.m.f. is produced. It does not depend upon

A) Resistance of the coil

B) Pole strength of the pole

C) Motion of the magnet

D) Number of turns of the coil

Q.13 When a wire loop is rotated in two poles of magnetic field, the direction of e.m.f. change once in every

A) 1 revolution

B) 2 revolution

C) $\frac{1}{4}$ revolution

D) $\frac{1}{2}$ revolution

Q.14 To induce an emf in a coil the linking magnetic flux

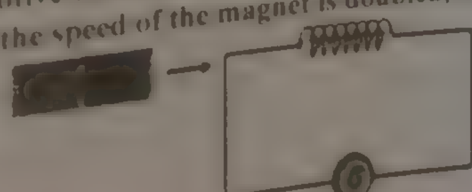
A) must decrease

B) must increase

C) must remain constant

D) can either increase or decrease

Q.15 As shown in the figure, a magnet is moved with a fast speed towards a coil at rest. Due to this induced electromotive force, induced current and induced charge in the coil is E, I and Q respectively. If the speed of the magnet is doubled, the incorrect statement



A) [illegible] increases

B) [illegible]

C) I increases

D) Q increases

Q.16 Two different loops are concentric and lie in the same plane. The current in the outer loop is clockwise and increasing with time. The induced current in the inner loop then, is

A) zero

B) counter clockwise

C) clockwise

D) in a direction that depends on the ratio of the loop radii

ALTERNATING CURRENT AND USE $V = V_o \sin\omega t$

Q.17 When a coil of cross-sectional area A and number of turns N is rotated in a uniform magnetic field B with angular velocity ω, then the maximum emf induced in the coil will be

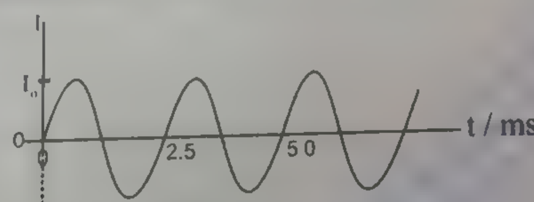
A) BNA

B) $\frac{Ba\omega}{N}$

C) $BNA\omega$

D) zero

Q.18 The graph shows how an alternating current I of peak value I_o varies with time t.



Which expression gives the alternating current I ?

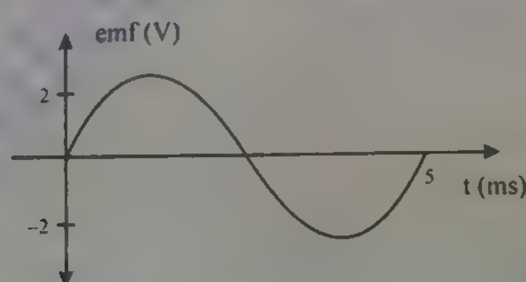
A) $I = I_o \sin(5\pi t)$

B) $I = I_o \sin\left(\frac{2\pi t}{2.5}\right)$

C) $I = I_o \sin\left(\frac{\pi t}{0.0025}\right)$

D) $I = I_o \sin(800\pi t)$

Q.19 The diagram shows how the e.m.f. of a simple generator varies with time. What is the frequency and the maximum value of the e.m.f?



	Frequency / Hz	Maximum e.m.f. / V
A)	200	2.0
B)	400	2.0
C)	200	4.0
D)	400	4.0

TRANSFORMER AND USES OF $\frac{N_s}{N_p}$, $\frac{V_s}{V_p}$, $\frac{I_s}{I_p}$ AND PRACTICAL TRANSFORMER

Q.20 Which quantity is increased in step-down transformer?

A) [illegible]
B) Voltage
C) Power
D) Frequency

Q.21 Which of the remain constant in a transformer?

A) current
B) power
C) potential
D) frequency

Q.22 The voltage in the primary and the secondary coils of a step-up transformer are 200 V and 4 kV respectively. If the current in the primary is 1 ampere then the current in the secondary coil will be

A) 50 mA
B) 5A
C) 500 mA
D) 5 mA

Q.23 The turn ratio of a transformer is 2:3. If the current through primary is 3A, then current through load resistance is

A) 1A
B) 2A
C) 4.5 A
D) 1.5 A

Q.24 A transformer is used to

A) Convert alternating current to direct current
B) Convert direct current to alternating current
C) Convert mechanical energy to electrical energy
D) change the level of alternating voltage

Q.25 A transformer is used to light a 100 W and 110 V lamp from 220 V mains. If the main current is 0.5 A, the efficiency of the transformer is approximately.

A) 10%
B) 50 %
C) 30%
D) 90 %

Q.26 If the current in the primary coil and number of turns in it are I_p and N_p respectively and the number of turns and current in the secondary are N_s and I_s respectively then the value the of $N_s : N_p$

A) $I_s : I_p$
B) $I_p : I_s$
C) $I_s^2 : I_p^2$
D) $I_p : I_s$

Q.27 The ratio of emf across primary coil to the emf across secondary coil is

A) $\frac{N_s}{N_p}$
B) $\frac{I_s}{I}$
C) $\frac{I_s}{I_p}$
D) None of these

Q.28 In step up transformer, voltage in the secondary increases and power in secondary

A) Remain same
B) Decreases because voltage increases
C) Increases because current decreases
D) May increases if voltage remain same

Q.29 In a transformer heat is produced due to eddy current in

A) Primary coil
B) iron core
C) Secondary coil
D) All of these

Q.30 ________ is the energy expended to magnetize and demagnetize the core material in each cycle of the A.C.
A) Power loss
B) Hysteresis loss
C) Heat loss
D) All of the above

Q.31 Laminated core in a transformer is used to reduce
A) Eddy current losses
B) Iron losses
C) Hysteresis losses
D) Heat losses due to resistance

Q.32 The loss of power in transformer is due to
A) Eddy current
B) Resistance of coils
C) Magnetic hysteresis
D) All

Q.33 A step-down transformer, transforms 220 volt to 11 volt. If the current in primary and secondary coil are 5A and 90 A respectively, efficiency of transformer is
A) 70%
B) 40%
C) 20%
D) 90%

Q.34 If turns in primary = 50, secondary = 200, primary voltage = 120V, primary current 3A, then output power will be about
A) 360 W
B) 300 W
C) 460 W
D) Zero

Q.35 To improve efficiency of transformer the flux coupling between primary & secondary coils should be
A) small
B) may be small or may be maximum
C) maximum
D) Zero

Q.36 Primary secondary coils of a transformer have 50 and 200 turns respectively. When primary is connected to 9 volt battery secondary voltage is
A) 90
B) 36
C) 18
D) Zero

PERIOD, FREQUENCY, PEAK VALUE AND ROOT MEAN SQUARE VALUE OF AN ALTERNATING CURRENT OR VOLTAGE

Q.37 A constant current of 2.8 A exists in a resistor. The rms current
A) 2.8 A
B) 1.4 A
C) about 2 A
D) undefined for a direct current

Q.38 The peak value of AC is $2\sqrt{2}$ ampere. Its apparent value will be
A) 1 ampere
B) 2 ampere
C) 4 ampere
D) zero

Q.39 The frequency of applied A.C. is 2 kHz. Its time period will be
A) 0.5×10^{-3} second
B) 5 second
C) 0.5 second
D) 2 second

Q.40 The power dissipated in a resistor is the same for a constant potential difference V and a sinusoidal potential difference with peak value V_0. Which of the following is the correct relationship between V and V_0?
A) $V_0 = \frac{V}{2}$
B) $V_0 = V$
C) $V_0 = \frac{V}{\sqrt{2}}$
D) $V_0 = \sqrt{2}\,V$

Q.41 A sinusoidal current has rms value 10 A, what is the peak value of current?

A) [illegible]

B) 0.14 A

C) 1.14 A

D) 144.1 A

Q.42 The mean value of sinusoidal emf over a cycle is

A) 2

B) 0

C) 1

D) 3

Q.43 If the instantaneous current in a circuit is gives by $I = 2\cos(\omega t + \Phi)$ ampere, the rms value of the current is

A) 2A

B) $2\sqrt{2}$ A

C) $\sqrt{2}$ A

D) zero

Q.44 Power is transmitted from a power house from high voltage AC because

A) Electric current travels faster at higher voltage

B) It is more economical due to less power wastage

C) It is difficult to generate power at a low voltage

D) Chances of stealing transmission lines are minimized

Q.45 In an A.C circuit instantaneous current is $-I_o$ it is possible when t =?

A) $t=\frac{T}{2}$

B) $t=\frac{3T}{4}$

C) $t=\frac{T}{4}$

D) $t=T$

Q.46 In an alternating voltage the instantaneous value is equal to $-V_0$. The phase angle at this instant is equal to

A) 0°

B) 180°

C) 90°

D) 270°

Q.47 If the instantaneous current in a circuit is given by $I=2\sin(\omega t+\theta)$ amperes, the rms value of the current is

A) $\sqrt{2}$ A

B) $2\sqrt{2}$ A

C) 2 A

D) zero

Q.48 An alternating current is represented by the equation $I = I_o\sin\omega t$, which of the following equation represents an alternating current of frequency and amplitude twice that of the above current?

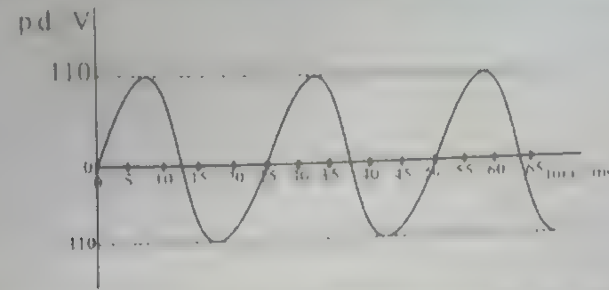
A) $I = 2I_o\sin(\omega t/2)$

B) $I=2I\sin\omega t$

C) $I = 2I_o\sin(2\omega t)$

D) $I = I_o\sin(2\omega t)$

Q.49 The graph shows how the potential difference across an alternating supply varies with



What are the frequencies f and the root-mean square potential difference V_{rms} of the a.c. sup

	f / Hz	V_{rms} / V
A)	40	156
B)	40	78
C)	400	156
D)	400	78

Q.50 Virtual value of alternating current is also called its root mean square value. The vir value of current $I = I_o \sin(\omega t + \phi)$ is

A) I_o

C) $\sqrt{2} I_o$

B) $\frac{2}{\pi} I_o$

D) $\frac{1}{\sqrt{2}} I_o$

ANSWER KEY

1	C	11	B	21	D	31	A	41	A
2	D	12	A	22	A	32	D	42	B
3	B	13	D	23	C	33	D	43	C
4	B	14	D	24	D	34	A	44	B
5	A	15	D	25	D	35	C	45	B
6	C	16	B	26	B	36	D	46	D
7	B	17	C	27	C	37	A	47	A
8	D	18	D	28	A	38	B	48	C
9	A	19	A	29	B	39	A	49	B
10	A	20	A	30	B	40	D	50	D

EXPLANATORY NOTES

Q.1 The magnetic induction B is the flux per unit area of a surface perpendicular to B, hence it is also called as flux density

$\phi = BA$

$B = \frac{\phi}{A}$ = flux density

Q.2 As

Flux density $= \frac{\phi}{A}$

So

Unit of flux density $\frac{Wb}{m^2}$

$= Wbm^{-2}$

$= NmA^{-1}m^{-2} \qquad \because Wb = NmA^{-1}$

$= Nm^{-1}A^{-1}$

$= T \qquad \because 1T = Nm^{-1}A^{-1}$

Q.3 When wire cuts the magnetic field then emf will be induced due to flux changing.

Q.4 $\phi = BA\cos 0°$

$\phi_{max} = BA \qquad \because \theta = 0°$

$\phi = \phi_{max} \cos\theta$

According to given condition

$\frac{\phi_{max}}{2} = \phi_{max} \cos\theta$

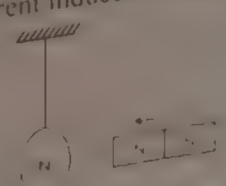
$\cos\theta = \frac{1}{2}$

$\theta = \cos^{-1}\left(\frac{1}{2}\right) = 60°$

Q.5 (i) A magnet falls with S-pole along the axis of ring. So according to Lenz's law S-pole form along the face of magnet. As shown in Fig. the current clock wise.
(ii) The ring is open. So, no current induced in the ring i.e I = 0

Q.6 It is the statement of Lenz's law.

Q.7 According to Lenz's law, the current induced in the ring oppose the cause that produce it



Q.8 [illegible] are correct by using Lenz's law.

Q.9 [illegible] $\frac{\Delta\phi}{\Delta t}$ [illegible] $\frac{\Delta\phi}{\Delta t}$

Q.10 $\varepsilon = N\left(\frac{\Delta B}{\Delta t}\right).A\cos\theta = 500\times 1\times\left(10\times 10^{-2}\right)^2\cos 0° = 5\text{ V}$

Q.11 $\varepsilon = \frac{\Delta\phi}{\Delta t} \Rightarrow IR = \frac{\Delta\phi}{\Delta t} \Rightarrow Q\Delta t = \frac{\Delta\phi}{R\Delta t}$

$\phi = \frac{10-2}{2} = 4C$

Q.12 $\varepsilon = -N\frac{\Delta\phi}{\Delta t}$

Q.13 For 1st half rotation, emf in sinusoidal wave above the mean line and for 2nd half rotation below the mean line.

Q.14 Induced emf can only be produced when magnetic flux changes.

Q.15 Induced charge doesn`t depend upon the speed of magnet. $(\varepsilon = VBL\sin\theta)$

Q.16 The induced current will be in such a direction so that it opposes the change due to which it is produced.

Q.17 As

$\varepsilon = N\omega AB\sin\theta$

For maximum induced emf $\theta = 90°$

$\varepsilon = N\omega AB$

Q.18 $I = I_o\sin\omega t = I_o\sin(2\pi f t)$

From the graph, the period T is 2.5 ms.

$\therefore$ Frequency, $f = \frac{1}{2.5\times 10^{-3}} = 400\text{ Hz}$

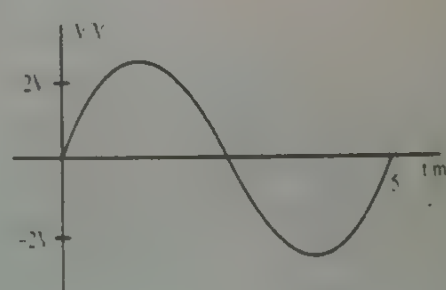
$\therefore$ $I = I_o\sin(2\pi(400)t) = I_o\sin(800\pi t)$

Q.19 From graph

$V_o = 2\text{ V}$

$T = 5\text{ ms}$

$= 5\times 10^{-3}\text{ sec}$



As

$f = \frac{1}{T} = \frac{1}{5\times 10^{-3}}$

$= \frac{10^3}{5} = \frac{1000}{5}$

$= 200\text{ Hz}$

Q.20 ...former is a device which is use to increase or decrease the alternating voltage.

$P = VI \Rightarrow P = \text{same} \Rightarrow V \propto \frac{1}{I}$

Q.21 As

$\frac{N_S}{N_P} = \frac{V_S}{V_P} = \frac{I_P}{I_S}$

From relation current and voltage changes. Only for ideal transformer power remain same otherwise power also changes. But frequency in transformer does not change.

Q.22 As

$\frac{V_S}{V_P} = \frac{I_P}{I_S}$

$\frac{4\times10^3}{200} = \frac{1}{I_S}$

$I_S = \frac{200}{4\times10^3}$

$= 50\times10^{-3}\,A = 50\,mA$

Q.23 As

$\frac{N_S}{N_P} = \frac{I_P}{I_S}$

$\frac{2}{3} = \frac{3}{I_S}$

$I_S = \frac{9}{2} = 4.5\,A$

Q.24 Because transformer only works with alternating voltage and it is used increase or decrease the alternating voltages.

Q.25 efficiency $= \frac{P_{output}}{P_{input}}\times100$

$= \frac{100}{V_P I_P}\times100$

$= \frac{100}{220\times0.5}\times100$

$= \frac{100}{110}\times100$

$= 90\%$

Q.26 As

$\frac{N_S}{N_P} = \frac{V_S}{V_P} = \frac{I_P}{I_S}$

Q.27 As

$\frac{V_s}{V_p} = \frac{I_p}{I_s} \Rightarrow \frac{V_s}{V_s} = \frac{I_s}{I_p}$

Q.28 In an ideal transformer power remain same.

Q.29 The magnetic flux changes through solid conductor (core material), induce current (eddy current) are setup in closed path in the body of conductor. It results in power dissipation, heating of core material.

Q.30 Hysteresis loss

Q.31 The insulation between lamination sheets should be perfect so as to stop the flow of eddy currents.

Q.32 (i) The eddy current results in power dissipation and heating of the core material

(ii) Hysteresis loss (magnetic hysteresis) is the energy spent to magnetize demagnetize the core material

(iii) The power also loss in transformer due to resistance of coil.

Q.33 $\eta = \frac{P_{output}}{P_{input}} \times 100\% = \frac{V_s I_s}{V_p I_p} = \frac{11(90)}{220(5)} = \frac{990}{1100} = 0.9$

$\%\eta = 0.9 \times 100\% = 90\%$

Q.34 $P_o = P_i = I_i V_i = 120 \times 3 = 360$ W

Q.35 Flux coupling between primary and secondary coils must be maximum.

Q.36 Voltage by a battery is D.C but transformer operates on A.C

Q.37 Constant current means direct current. In case of D.C $I_{rms} = I$

Q.38 As apparent value of A.C means its root mean square value.

$$I_{rms} = \frac{I_o}{\sqrt{2}}$$

$$= \frac{2\sqrt{2}}{\sqrt{2}}$$

$$= 2A$$

Q.39 As

$$f = \frac{1}{T}$$

$$\Rightarrow T = \frac{1}{f} = \frac{1}{2 \times 10^3}$$

$$= 0.5 \times 10^{-3} \text{ sec}$$

Q.40 The power dissipated in a resistor for a constant potential difference V is the same as root mean square value of a sinusoidal alternating potential difference.

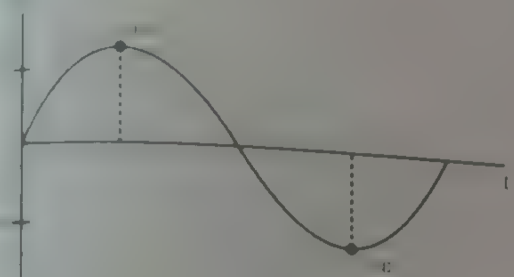
$$V_{rms} = \frac{V_o}{\sqrt{2}}$$

$$V = \frac{V_o}{\sqrt{2}} \Rightarrow V_o = \sqrt{2}\, V$$

$= \sqrt{2}\, I_{rms}$

$= (1.414)(10) = 14.14\,A$

Q.42 $= \frac{\varepsilon_o + (-\varepsilon_o)}{2} = 0$



Q.43 As $I = I_o \cos\theta$ ——— (1)

Given equation

$I = 2\cos(\omega t + \phi)$ — (2)

From equation (1) & (2)

$I_o = 2A$

Now

$I_{rms} = \frac{I_o}{\sqrt{2}} = \frac{2}{\sqrt{2}}$

$= \frac{\sqrt{2}\sqrt{2}}{\sqrt{2}} = \sqrt{2}\,A$

Q.44 When A.C voltage is high, current will be less. As power loss = $I^2 R$, there will be less power loss $\left(V \propto \frac{1}{I}\text{ in transformer}\right) \downarrow H = I^2 \downarrow Rt$

Q.45 As $I = I_o \sin\theta$

$I = I_o \sin\left(\frac{2\pi}{T} \times t\right)$ $\quad \because \theta = \omega t = \frac{2\pi}{T} \times t$

$-I_o = I_o \sin\left(\frac{2\pi}{T} \times t\right)$

$\sin^{-1}(-1) = \frac{2\pi}{T} \times t$

$\frac{3\pi}{2} = \frac{2\pi}{T} \times t$ $\quad \because \sin^{-1}(-1) = 270^\circ = \frac{3\pi}{2}$

$\therefore t = \frac{3T}{4}$

Q.46 $V = V_o \sin\theta \quad \therefore \theta = 270^\circ \quad V = V_o(-1) = -V_o$

Q.47 $I_{rms} = \frac{I_o}{\sqrt{2}} = \frac{2}{\sqrt{2}} = \sqrt{2}$

Q.48 $I = I_o \sin\omega t$

$I' = (2I_o)\sin(2\omega t) \quad I_o \to 2I_o$

$\omega \to 2\omega$

Q.49 $V_{rms} = \frac{V}{\sqrt{2}} = \frac{110}{\sqrt{2}} = 78\ V$

$f = \frac{1}{T} = \frac{1}{25 \times 10^{-3}} = 40\ Hz$

Q.50 $I_{rms} = \frac{I_o}{\sqrt{2}}$

PAST PAPER MCQ's (2008-2019)

2008

Q.1 In a step-down transformer the output current ________:
A) Reduced
B) Increased
C) Remains same
D) None of these

Q.2 The Lenz's law refers to induced ________:
A) [illegible]
B) Resistance
C) Shear
D) Currents

2009

Q.3 Power losses in a transformer can be minimized:
A) By increasing turn ratio
B) By decreasing turn ratio
C) By stopping the flow of Eddy currents
D) Using material of the core whose hysteresis area is large

2017

Q.4 The magnetic flux linked with a solenoid of area 'A', having 'N' turns and right angle to field 'B' is:
A) BA
B) (1/2) NBA
C) NBA
D) BA cosθ

Q.5 A loop of 5 turns of wire is placed in uniform magnetic field of 0.5T. Then area of loop shrinks at constant rate $10 m^2/s$. Emf induced in the loop is:
A) 25V
B) 2.5V
C) 250V
D) 0.25V

Q.6 The phase at negative peak of AC voltage is:
A) $\pi/2$
B) π
C) $2\pi/3$
D) $3\pi/2$

Q.7 If the value of magnetic flux is 10 Wb, when magnetic lines of force containing magnetic field strength of 1 tesla passing through unit area of $10 m^2$ then the angle between magnetic field and unit area is:
A) 180°
B) 360°
C) 90°
D) 0°

Retake 2017

Q.8 A coil is rotated in a uniform magnetic field about an axis perpendicular to the field. The induced in the coil would be maximum when the plane of the coil is:
A) Parallel to the field
B) Perpendicular to the field
C) At 45° to the field
D) None of them

2018

Q.9 A metal rod of length 10.0 cm is moving at a speed of $0.5 ms^{-1}$ in a direction perpendicular to a 0.20 T magnetic field. Find emf produced in the rod.
A) $2.0 \times 10^{[illegible]} V$
B) $0.50 \times 10^{[illegible]} V$
C) $1.0 \times 10^{-2} V$
D) $1.0 \times 10^{-3} V$

Q.10 In a practical transformer mutual induction between primary and secondary coils takes place. In such transformer what can be deduced about the power
A) Power output = power input
B) Power output > power input
C) Power output ≥ power input
D) Power output < power input

Q.11 Lenz's law in electromagnetic induction is the direct consequence of the principle of conservation of

A) energy
B) charge
C) momentum
D) mass

2019

Q.12 If we give a direct current to the transformer's primary coil, then there will be:

A) less emf produced in the secondary
B) no emf produced in the secondary
C) equal emf produced in the secondary
D) more emf produced in the secondary

Q.13 An alternating voltage V (in volts) is represented by the equation:
$V = 300 \sin(100\pi t)$ What is the value of "f" for this voltage?

A) 25 Hz
B) 200 Hz
C) 50 Hz
D) 100 Hz

Q.14 If we change the magnetic flux linking a coil by rotating the coil in a constant magnetic field, the rate of change of this flux is:

A) proportional to the emf produced in it
B) proportional to the change in magnetic field
C) proportional to the resistance of the coil
D) proportional to the material of the coil

ANSWER KEY

1	B	11	A
2	D	12	B
3	C	13	C
4	C	14	A
5	A		
6	D		
7	D		
8	A		
9	C		
10	D		

EXPLANATORY NOTES

Q.1 Step down transformer, V ... V, So V decreases and I, increase
Q.2 Lenz,s Law refers to induce currents in a closed circuits.
Q.3 Power losses in transformer is due to
i) eddy currents
ii) Magnetic Hysteresis
Q.4 $\phi = NBA$
Q.5 $\frac{NBA A}{\Delta t}$ $5 \times 0.5 \times 10 = 25\,V$
Q.6 at $\frac{\pi}{2}$, *Phase is positive*

at $\frac{3\pi}{2}$, *Phase is negitive*

at $0, \pi, 2\pi$, *Phase is zero*

Q.7

$\phi = BA\cos\theta$

$10 = (1)(10) = \cos\theta$

$0° = \cos^{-1}(1) = \theta$

Q.8 The induced emf in a coil would be maximum, when the plane of coils is parallel to field.
Q.9 $\varepsilon = vBl \Rightarrow \varepsilon = \frac{5}{10} \times \frac{20}{100} \times \frac{10}{100} = \frac{1}{100} = 1.0 \times 10^{-2} V$
Q.10 $P_{in} = P_{out}$ (Ideal Transformer)
$P_{in} \neq P_{out}$ (real transformer) due to losses
Q.11 Mechanical energy is converted into electrical energy. So, low of conservation of energy holds.
Q.12 Transformer does not work on direct current.
Q.13 $\omega = 2\pi f = 100\pi$
$f = 50\,Hz$
Q.14 $\varepsilon = N\frac{\Delta\phi}{\Delta t}$

$\varepsilon \propto \frac{\Delta\phi}{\Delta t}$ N = Constant

TOPIC-13 DEFORMATION OF SOLIDS

PRACTICE EXERCISE

TOPIC-WISE MCQ's

STRESS, STRAIN AND YOUNG'S MODULUS

Q.1 Two wires of the same material and length have diameters in the ratio 2 : 1. If they are stretched by the same force, their elongations will be in the ratio

A) 8 : 1 C) 1 : 8

B) 2 : 1 D) 1 : 4

Q.2 A force 'F' is needed to break a copper wire having radius 'R'. The force needed to break copper wire of same length and radius 2 R will be?

A) $\frac{F}{2}$ C) 2 F

B) 4 F D) $\frac{F}{4}$

Q.3 A 1m long Cu wire is subjected to a stretching force such that its length increases by 40cm. The % elongation which the wire undergoes:

A) 20% C) 40%

B) 60% D) 50%

Q.4 The young's modulus for a perfectly Rigid body is

A) Zero C) 1

B) Infinite D) Lies between 1 and zero

Q.5 The ratio of diameters of two wires of same material is n:1. The length of each wire is 4m. On applying the same load, the increase in the length of thin wire will be, (n> 1)

A) n^2 times C) n times

B) 2n times D) (2n+1) × times

Q.6 A and B are two wires. The radius of A is twice than that of B. They are stretched by the same load, then stress on B is

A) Equal to that of A C) Four times that of A

B) 2 times that of A D) Half times that of A

Q.7 In an experiment for determination of young modulus of the material of wire. The length of the wire and suspended mass both are doubled, then the young modulus

A) Remains unchanged C) Becomes doubled

B) becomes four times D) Becomes sixteen times

Q.8 If the change of length of wire equal to the original length, then its young modulus is equal to

A) Stress C) Strain

B) load applied D) None of these

Q.9 The unit of stress are:

A) kg $m^{-1} s^{-1}$ C) kg $m^{-2} s^{-2}$

B) kg $m^{-1} s^{-2}$ D) kg $m^{-2} s^{-3}$

Q.10 Volumetric strain can be defined as:

A) $V_o \times \Delta V$ C) [illegible]

B) [illegible] D) [illegible]

Shear modulus, mathematically can be written as:

A) [illegible]

B) $G = \frac{\frac{F}{A}}{\frac{\Delta l}{l}}$

C) $G = \frac{\frac{F}{A}}{[illegible]}$

D) $G = \frac{\frac{F}{A}}{\frac{-\Delta V}{V}}$

Q.12 Young's modulus of steel is 2×10^{11} N/m^2. A steel wire has a length of 1m and area of cross section 1mm^2. The work required to increase its length by 1mm is

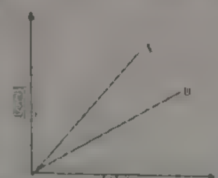
A) [illegible]

B) 1 J

C) 10 J

D) 0.1 J

Q.13 The dimensions of two wires A and B are same. But their materials are different. Their load-extension graph is shown.



If Y_A and Y_B are values of young's modulus of elasticity of A and B respectively then

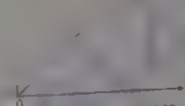
A) $Y_A > Y_B$

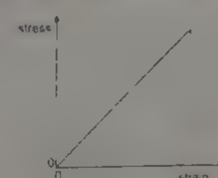
B) $Y_A = Y_B$

C) $Y_A < Y_B$

D) $Y_B = 2Y_A$

Q.14 The graphs show how force varies with extension and stress varies with strain for the loading of a metal wire.





The Young modulus for this wire is equal to

A) the gradient of the force-extension graph

B) the area between the force-extension graph and the extension axis.

C) the gradient of the stress-strain graph

D) the area between the stress-strain graph and the strain axis.

Q.15 The strain of magnitude 4.4×10^{-4} has been noted when certain stress is applied on a wire of 11 meter. The wire is then stretched by an amount of:

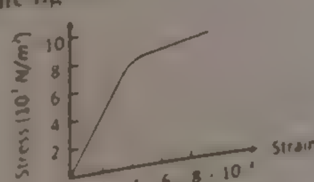
A) 4.84 m

B) 4.84 cm

C) 4.84 mm

D) 4.84 μ m

Q.16 Which one of the following is the Young's modulus (in N/m^2) for the wire having the stress-strain curve shown in the figure?



A) 1.0×10^{11}

B) 8.0×10^{11}

C) 2.0×10^{11}

D) 2.4×10^{11}

Q.17 The length of an iron wire is L and area of cross-section is A. The increase in length is l on applying the force F on its two ends. Which of the statement is correct?

A) increase in length is proportional to Young's modulus

B) increase in length is inversely proportional to its length L

C) increase in length is inversely proportional to A

D) increase in length is proportional to area of cross-section A

Q.18 When a certain weight is suspended from a long uniform wire, its length increases by one cm. If the same weight is suspended from another wire of the same material and length but having a diameter half of the first one then the increase in length will be

A) 4 cm C) 10 cm

B) 2 cm D) 0.5 cm

Q.19 A and B are two wires. The radius of A is twice that of B. They are stretched by the same load. Then the stress on B is

A) four times that on A C) two times that on A

B) half that on A D) equal to A

Q.20 The area of cross-section of a wire of length 1.1 meter is 1 mm^2. It is loaded with 1 kg. If Young's modulus of copper is $1.1\times10^{11} N/m^2$, then the increase in length will be (If $g=10 m/s^2$)

A) 0.075 mm C) 0.1 mm

B) 0.01 mm D) 0. 15 mm

Q.21 To double the length of an iron wire having 0.5 cm^2 area of cross section, the required force will be? ($Y = 10^{12}$ $dyne/cm^2$)

A) 1.0×10^{-7} N C) 1.0×10^{7} N

B) 0.5×10^{-7} N D) 0.5×10^{12} dyne

Q.22 For a constant force, a rope breaks due to stress. Which of the following is useful to reduce the stress?

A) Increase the length of the rope

B) Apply small force

C) Increase the cross-sectional area of the rope

D) Use a different material of rope

Q.23 A cube is subjected to a uniform volume compression. If the side of the cube decreases by 2%, the bulk strain is

A) 0.02 C) 0.04

B) 0.03 D) 0.06

TENSILE STRESS AND STRAIN

Q.24 Two wires have the same material and have the same volume. However, wire 1 has cross sectional are A and wire 2 has cross sectional rea 3A. If the length of wire 1 increases by Δx on applying force F, how much force is needed to stretch wire 2 by the same amount?

A) F

B) 4F C) 6F

D) 9F

Q.25 **Tensile stress addresses to the:**
A) Volume changes due to the applied stress
B) Length changes due to the applied stress
C) Shape changes due to the applied stress
D) Angle changes due to applied stress

Q.26 **For the constant hydraulic stress on an object, the fractional change in the object's volume $\left(\frac{\Delta V}{V}\right)$ and its bulk modulus (B) are related as.**
A) $\frac{\Delta V}{V} \propto B$
B) $\frac{\Delta V}{V} \propto B^{-1}$
C) $\frac{\Delta V}{V} \propto B^2$
D) $\frac{\Delta V}{V} \propto B^{-2}$

Q.27 **The strain produced due to compressive stress is called:**
A) Tensile strain
B) Volumetric strain
C) Shear strain
D) Compressive strain

HOOK'S LAW

Q.28 **Which of the following is correct?**
A) Hooke's law is applicable only within elastic limit
B) The adiabatic and isothermal elastic constants of a gas are equal
C) Young's modulus is dimensionless
D) Stress multiplied by strain is equal to energy stored

Q.29 **The ratio of stress to strain is a constant for a given material, provided the external applied force**
A) Remain constant
B) Not too small
C) Not too great
D) No applied force

Q.30 **Two steel wires P and Q have lengths ℓ and 2ℓ respectively, and cross-sectional areas A and $\frac{A}{2}$ respectively. Both wires obey Hooke's law. What is the ratio $\frac{\text{tension in P}}{\text{tension in Q}}$ when both wires are stretched to the same extension?**
A) $\frac{1}{4}$
B) $\frac{1}{2}$
C) $\frac{2}{1}$
D) $\frac{4}{1}$

Q.31 **A wire stretches 8 mm under a load of 60 N. A second wire of the same material, with half the diameter and a quarter of the original length of the first wire, is stretched by the same load. Assuming that Hooke's law is obeyed, what is the extension of this wire?**
A) 1 mm
B) 4 mm
C) 8 mm
D) 16 mm

Q.32 **For a wire, Hooke's law is obeyed for a tension F and extension x. The Young modulus for the material of the wire is E.**
Which expression represents the elastic strain energy stored in the wire?
A) $\frac{1}{2}$ Ex
B) Ex
C) $\frac{1}{2}$ Fx
D) Fx

Q.33 What happens when the stress applied to the body is increased beyond the maximum value and is removed after some time?

A) The body will come back to its original position

B) The body will oppose the stress

C) The body becomes hot

D) The body cannot return to its original position

ELASTIC AND PLASTIC DEFORMATION OF A MATERIAL

Q.34 The nominal strength of a material under the action of a certain stress:

A) Mechanical strength
C) Absolute tensile strength
B) Elastic strength
D) Ultimate tensile strength

Q.35 A spring is made of steel and not of copper because

A) Elasticity of steel is greater than that of copper

B) Elasticity of steel is less than that of copper

C) Plasticity of copper is greater than steel

D) Plasticity of steel is greater than copper

Q.36 If fracture stress is represented by 'σ_f' and an ultimate tensile strength by 'σ_m' then:

A) $\sigma_m > \sigma_f$
C) $\sigma_m < \sigma_f$
B) $\sigma_m = \sigma_f$
D) None of these

Q.37 Any change produced in shapes, length or volume when a body is subjected to some external force is called:

A) Polymerization
C) Polarization
B) Crystallization
D) Deformation

Q.38 Maximum stress which a body can bear is called

A) Yield stress
C) Elastic limit
B) Plasticity
D) UTS

Q.39 If stress is increased beyond the elastic limit of the material, it becomes permanently changed, this behaviour is called:

A) Elasticity
C) Plasticity
B) Yield strength
D) All of these

Q.40 Which row best defines elastic and plastic behaviour of a material?

	Elastic behavior of a material	Plastic behavior of a material
A)	extends only within the limit of	Extends beyond the limit of pr...
B)	proportionality has a linear force-extension	has a horizontal force-exte...
C)	curve obeys Hooke's law returns to its	extends continuously under a ...
D)	original shape and size	suffers permanent deforma...

Q.41 **In a wire, when elongation is 2 cm energy stored is E, if it is stretched by 10 cm, then the energy stored will be**

A) E
B) 2 E
C) 4 E
D) 25 E

Q.42 **A wire fixed at the upper end and stretches by length 'l' by applying a force 'F'. The work done in stretching is**

A) 2 Fl
B) $\frac{F}{2l}$
C) Fl
D) $\frac{Fl}{2}$

Q.43 **The strain energy possessed by a deformed material is:**

A) Volume of the force extension curve
B) Area under the force extension curve
C) Slope of the force extension curve
D) Derivative of the force extension curve

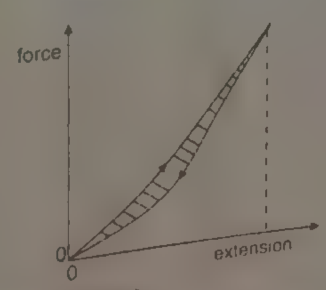
Q.44 **Area method for determining the stored energy in a deformed material is valid for:**

A) Linear part of the force extension curve
B) Nonlinear part of the force extension curve
C) Both of the above
D) None of the above

Q.45 **The work done per unit volume in stretching a material wire is**

A) $\frac{1}{2}$ force × extension
B) Force × extension
C) $\frac{1}{2}$ stress × strain
D) Stress × Strain

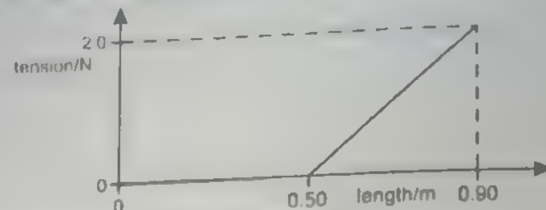
Q.46 **The force-extension graph of a particular sample of rubber as a load is applied and then removed is shown.**



What does the shaded area represent?

A) the energy transformed into heat during the complete cycle
B) the recoverable elastic potential energy stored at maximum extension
C) the work done on the sample while loading
D) the work done on the sample while unloading

Q.47 A spring of unexpended length 0.50 m is stretched by a force of 2.0 N to a new length of 0.90 m. The variation of its length with tension is as shown.



How much strain energy is stored in the spring?

A) 0.40 J
B) 0.80 J
C) 0.90 J
D) 1.8 J

Q.48 **Two wires of same diameter of the same material having the length *l* and 2*l*. If the force F is applied on each, the ratio of the work done in the two wires will be**

A) 1:2
B) 1:1
C) 2:1
D) 1:4

BAND THEORY, VALENCE BAND, CONDUCTION BAND AND FORBIDDEN BAND

Q.49 **The forbidden gap in semiconductors is of the order of**

A) 5 eV
B) 1 eV
C) 50 eV
D) 10 eV

Q.50 **The conduction band lies**

A) between valance band and forbidden gap
B) below the valance band
C) above the forbidden gap
D) below the forbidden gap

ANSWER KEY

1	D	11	C	21	D	31	C	41	D
2	B	12	D	22	C	32	C	42	D
3	C	13	A	23	D	33	D	43	B
4	B	14	C	24	D	34	D	44	C
5	A	15	C	25	B	35	A	45	C
6	C	16	C	26	B	36	A	46	A
7	A	17	C	27	A	37	D	47	A
8	A	18	A	28	A	38	D	48	A
9	B	19	A	29	C	39	C	49	B
10	D	20	C	30	D	40	D	50	C

EXPLANATORY NOTES

[illegible]

Δl [illegible] Y [illegible] $\dfrac{1}{\pi\left(\dfrac{d}{2}\right)^2} \Rightarrow \Delta l \propto \dfrac{1}{d^2}$

$\dfrac{\Delta l_1}{\Delta l_2} = \dfrac{(d_2)^2}{(d_1)^2} = \dfrac{(1)^2}{(2)^2} \Rightarrow \Delta l_1 : \Delta l_2 = 1:2$

Q.2 [illegible] (σ constant)

$\dfrac{F_2}{F_1} = \dfrac{\pi(r_2)^2}{\pi(r_1)^2} \Rightarrow \dfrac{F_2}{F_1} = \dfrac{\pi(2r_1)^2}{\pi(r_1)^2} \Rightarrow F_2 = 4F_1$

Q.3 [illegible] $\dfrac{\Delta l}{l} \times 100$ [illegible] $\dfrac{40\,cm}{100\,cm} \times 100 \Rightarrow \varepsilon\% = 40\%$

Q.4 For perfect rigid body, $\Delta l = 0$ we know that $Y = \dfrac{F/A}{\Delta l / l} = \dfrac{F/A}{0} = \infty$

Q.5 $Y = \dfrac{Fl}{A\Delta L}$, same load and length

$\Delta L \propto \dfrac{1}{A} \Rightarrow \dfrac{\Delta L_1}{\Delta L_2} = \dfrac{\pi r_2^2}{\pi r_1^2} = \dfrac{1^2}{n^2}$

$\Delta L_2 = n^2 \Delta L_1$

Q.6 $\sigma \propto \dfrac{1}{A} \Rightarrow \sigma A =$ constant (σ & A are inversely proportional)

$\dfrac{\sigma_B}{\sigma_A} = \dfrac{A_A}{A_B} = \dfrac{\pi r_A^2}{\pi r_B^2} \Rightarrow \dfrac{\sigma_B}{\sigma_A} = \dfrac{(2r_B)^2}{r_B^2} \Rightarrow \sigma_B = 4\sigma_A$

Q.7 Young's modulus depends upon temperature and nature of the material, it is independent of dimensions.

Q.8 [illegible] $\dfrac{\Delta l}{l}$ [illegible] $\Rightarrow Y = \dfrac{F}{A} = \sigma$

Q.9 $\sigma = \dfrac{F}{A} = \dfrac{kg\,m\,s^{-2}}{m^2} = kg\,m^{-1}\,s^{-2} \Rightarrow [ML^{-1}T^{-2}]$

Q.10 Volumetric Strain $= \dfrac{\text{Change in volume}}{\text{Original volume}}$

Q.11 [illegible] shear modulus [illegible]

Q.12 [illegible]

Q.13 From graph: $Y = \frac{F}{A} \times \frac{\ell}{\Delta \ell} \Rightarrow \frac{Y_A}{Y_B} = \frac{F_A}{F_B} \times \frac{\Delta \ell_B}{\Delta \ell_A}$

$F_A > F_B$ and $\Delta \ell_A < \Delta \ell_B$ So $Y_A > Y_B$

Q.14 Slope of stress strain graph $\frac{\Delta y}{\Delta x} \rightarrow$ Young's Modulus $= \frac{\text{Stress}}{\text{strain}}$

Q.15 $\varepsilon = \frac{\Delta l}{l} \Rightarrow \Delta l = \varepsilon \times L = 4.4 \times 10$ [illegible] $\times 11 = 4.84 \times 10$ [illegible] m

Q.16 Young's modulus is defined only in elastic region and

$$Y = \frac{\text{Stress}}{\text{Strain}} = \frac{8 \times 10^7}{4 \times 10^{-4}} = 2 \times 10^{11}\ \text{N/m}^2$$

Q.17 $l = \frac{FL}{YA} \Rightarrow l \propto \frac{1}{A}$

Q.18 $l = \frac{FL}{AY} \Rightarrow l \propto \frac{1}{r^2}$ (F, L and Y are constant) $\frac{l_2}{l_1} = \left(\frac{r_1}{r_2}\right)^2 = (2)^2 = 4 \Rightarrow l_2 = 4l_1 = 4\text{cm}$

Q.19 $\text{Stress} = \frac{\text{Force}}{\text{Area}} \Rightarrow \text{Stress} \propto \frac{1}{\pi r^2}$ $\quad \frac{S_B}{S_A} = \left(\frac{r_A}{r_B}\right)^2 = (2)^2 \Rightarrow S_B = 4S_A$

Q.20 $Y = \frac{F/A}{\Delta L/L} = \frac{FL}{A\Delta L}$

$$\Delta L = \frac{mgL}{AY} = \frac{1 \times 10 \times 1.1}{1.1 \times 10^{11} \times 10^{-6}}\text{m} = 0.1\ \text{mm}$$

Q.21 $Y = \frac{F/A}{\Delta l/l} \Rightarrow Y = \frac{F/A}{\frac{2l - l}{l}} \Rightarrow Y = F/A$

$$F = Y \times A \Rightarrow F = 10^{12}\frac{dyne}{cm^2} \times 0.5\,cm^2 \Rightarrow F = 0.5 \times 10^{12}\ dyne$$

Q.22 Stress = Force/Area

For a constant force, if the area is small, stress is large. If the area is large, stress is small. Therefore, by increasing the cross sectional area stress can be reduced considerably.

Q.23 $V = l^3$

$\Delta V/V = 3\Delta l/l = 3(2/10) = 0.06$

Q.24 $Y = \frac{FL}{A\Delta L} \cdot \frac{A}{A} = \frac{FLA}{A^2\Delta L} = \frac{FV}{A^2\Delta L}$

$F \propto A^2$

$F' = (3A)^2$

$F'/F = 9$

$F' = 9F$

... proportional strain it state Hook's Law.

... value of stress.

$$\frac{l_1}{l_2} = \frac{A_1}{A_2} \times \frac{\ell_2}{\ell_1}$$

$$\Delta L \propto \frac{L}{d^2} \Rightarrow \frac{\Delta L_1}{\Delta L_2} = \frac{L_1}{L_2} \times \frac{d_2^2}{d_1^2}$$

... F – x graph = energy ⇒ Energy = $\frac{1}{2}$(base)(height) ⇒ Energy = $\frac{1}{2}$ Fx

When the applied stress exceeds the maximum value the body does not regain its original position completely after removing external forces. It is said to have reached its elastic limit

Definition of UTS.

Steel is more elastic than copper

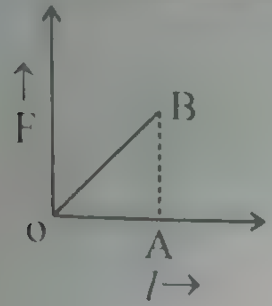
... book shows that ...

... maximum stress that a material can withstand and can be regarded as the ...

If specimen becomes permanently changed and does not recover its original shape or dimension after the stress is removed. This kind of behaviour is called plasticity

By definition Pro...

Q.42 In such a situation the work is calculated by graphical method.



Work done = Area $\Delta OAB \Rightarrow W = \frac{1}{2}Fl$

Q.43 In such a situation the energy is equal to area under force-extension graph.

Q.44 Strain energy in deformed material can be calculated by area method for both linear and non linear part of force extension curve.

Q.45 $E = W = \frac{1}{2}F\Delta\ell \Rightarrow \frac{E}{V} = \frac{1}{2}\frac{F}{A}\times\frac{\Delta\ell}{\ell} \Rightarrow \frac{E}{V} = \frac{1}{2}$ stress $\times$ strain

Q.46 Area under $F-x$ graph $= \Delta y \times \Delta x \Rightarrow$ energy $= Fx$

The shaded area represents the energy transformed into heat during the complete cycle.

Q.47 Energy $= \frac{1}{2}\times$ base $\times$ height $= \frac{1}{2}\times 0.40\times 2$

Energy $= 0.40\,J$

Q.48 $W = \frac{1}{2}F\ell \Rightarrow W \propto \ell$ (If F is constant) $\Rightarrow \frac{W_1}{W_2} = \frac{\ell_1}{\ell_2} = \frac{\ell}{2\ell} = \frac{1}{2}$

Q.49 The forbidden gap in semiconductors is of the order of 1 eV

Q.50 The conduction band lies above the forbidden gap

PAST PAPER MCQ's (2008-2019)

Q.1 **Which of the following is the most ductile?**

A) Glass
B) Copper
C) Cast iron
D) High carbon steel

2011

Q.2 **A wire is stretched by a force which causes an extension. The energy is stored in it only when:**

A) The extension of wire is proportional to force applied
B) The cross-section area of the wire remains constant
C) The wire is not stretched beyond its elastic limit
D) The weight of wire is negligible

Q.3 **Which statement is correct:**

A) Elasticity is that property of body which enables body to regain its original dimension
B) Elasticity is that property of a body that does not allow it to return to its original shape
C) Elasticity is that property of a body that allows it to retain its original shape and dimension after the stress is removed
D) Elasticity is that property of a body that obeys Hooke's law

2012

Q.4 **A wire is stretched by a force 'F' which causes an extension Δx, the energy stored in the wire is:**

A) $F\Delta x$
B) $2F\Delta x$
C) $\frac{1}{2}F\Delta x^2$
D) $\frac{1}{2}F\Delta x$

Q.5 **The ratio of tensile stress and the tensile strain is called:**

A) Modulus of elasticity
B) Bulk Modulus
C) Young's Modulus
D) Shear Modulus

2013

Q.6 **A 4.0 m^2 long wire is subjected to stretching force and its length increase by 40cm. The percent elongation which the wire undergoes is**

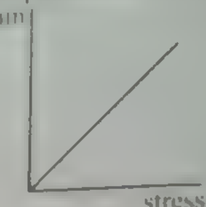
A) 0.10%
B) 40.10%
C) 10%
D) 20.10%

Q.7 **The stress-strain graph, deduced the following limits reach successively:**

A) Proportional limit, elastic limit, yield limit
B) Proportional limit, yield limit, elastic limit
C) Yield limit, elastic limit, proportional limit
D) Elastic limit, proportional limit, yield limit

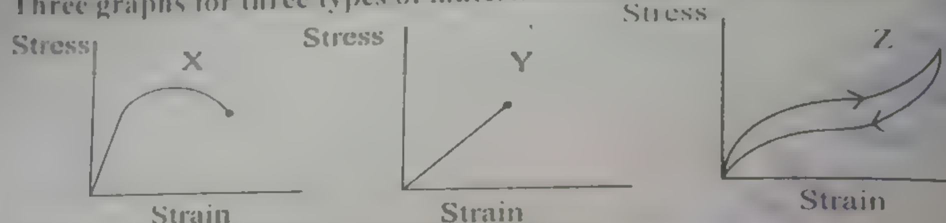
2014

Q. 8 Which feature of the following graph represents Young's Modulus?



A) Area under graph
B) Gradient of the graph
C) Reciprocal of the gradient
D) Product of gradient area of the curve

Q. 9 Three graphs for three types of materials are shown in the figure.



Which row describes the correct materials?

	X	Y	Z
A)	Brittle	Ductile	Polymer
B)	Brittle	Polymer	Ductile
C)	Polymer	Brittle	Ductile
D)	Ductile	Brittle	Polymer

2015

Q. 10 A wire of area of cross –section 'A' and original length 'l' is subjected to a load 'L' second wire same material with an area is '2A' and length '2l' is subjected to the same load 'L'. If the extension first wire is 'X' and second wire is 'Y' find the ratio 'X Y'.

A) $\frac{1}{4}$
B) $\frac{1}{2}$
C) $\frac{1}{1}$
D) $\frac{2}{1}$

Q. 11 Strain energy in a deformed material is stored in the form of:
A) Elastic energy
B) Potential energy
C) Plastic energy
D) kinetic energy

2016

Q. 12 The wire made of copper belong to which specific kind of material?
A) Ductile material
B) Tough material
C) Brittle material
D) Deformed material

2017

Q. 13 A 1.25cm diameter cylinder is subjected to a load of 2500Kg. Calculate the stress of
A) 2×10^8 Pa
B) 200 Pa
C) 2×10^6 Pa
D) 2×10^7 Pa

Q. 14 A wire of length 2m is attached with a mass of 2kg vertically. If tensile strain in the is 0.3×10^{-3} then extension in wire will be:
A) 1.5mm
B) 2.0mm
C) 0.6mm

Retake 2017

Q. 15 The young's modulus of elasticity of a wire is "Y" and stress is "F". The elastic P.E per unit volume in the wire be:

A) $F^2/2Y$
B) $Y^2/2F$
C) F^2/Y
D) Y^2/F^2

Q. 16 The modulus of elasticity depends upon:

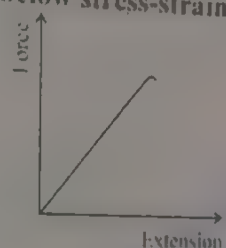
A) Nature of the material
B) Temperature
C) Area of cross-section
D) Both "A" & "B"

2018

Q. 17 In the case of linear deformation, the ratio of tensile stress to tensile strain is called:

A) energy stored in a stretched
B) young's double slit phenomenon
C) Bulk modulus
D) Young's modulus

Q. 18 Which material will follow the below stress-strain curve?



A) Copper
B) Iron
C) Lead
D) Glass

2019

Q. 19 The area under the extension-load graph of an elastic material whose elastic limit has not been exceeded gives its:

A) stress
B) strain energy
C) Young modulus
D) strain

Q. 20 A wire has spring constant of $5 \times 10^4 N\ m^{-1}$. Its is stretched by a force to extension of 1.4 mm. Calculate the strain energy stored in the wire.

A) $4.9 \times 10^{-5} J$
B) 4.9 J
C) $4.9 \times 10^{-5} J$
D) $4.9 \times 10^{-2} J$

ANSWER KEY

1	B	11	B
[illegible]	A	[illegible]	A
[illegible]	C	[illegible]	A
[illegible]	D	14	C
[illegible]	C	15	A
[illegible]	C	16	D
[illegible]	A	17	D
[illegible]	B	[illegible]	D
[illegible]	D	[illegible]	B
10	C	20	D

EXPLANATORY NOTES

Q. 1 Copper is most ductile

Q. 2 Energy is stored in stretched wire by a force only when the extension of wire is proportional to applied force.

Q. 3 Definition of elasticity.

Q. 4 $W = \frac{1}{2} F \Delta x$

Q. 5 $Y = \frac{\text{Tensile stress}}{\text{Tensile Strain}} = \frac{F/A}{\Delta \ell/\ell}$

Q. 6 $\frac{\Delta \ell}{\ell} = \frac{40 \times 10^{-2}}{4} = 10 \times 10^{-2} = \frac{10}{100} \times 100\% = 10\%$

Q. 7 In stress - strain graph, order is proportional limit, yield Point, elastic limit, UTS, fracture stress.

Q. 8 $Gradient = Slops = \frac{Strain}{Stress} = \frac{1}{Y}$

Q. 9 Ductile materials go towards permanent deformation after elastic limit. Brittle materials break just after elastic limits

Q. 10 $\Delta L = \frac{FL}{AY}$

$$\frac{\Delta L_1}{\Delta L_2} = \frac{F_1}{F_2} \times \frac{L_1}{L_2} \times \frac{A_2}{A_1} \times \frac{Y_2}{Y_1}$$

Material and load are same so Y and F are same respectively

$$\frac{\Delta L_1}{\Delta L_2} = \frac{L_1}{L_2} \times \frac{A_2}{A_1} = \frac{L_1}{2L_1} \times \frac{2A_1}{2A_1} = \frac{1}{1}$$

Q. 11 Strain energy is stored as elastic potential energy.

Work is done as energy stored energy stored is in the form of elastic potential energy

Q. 12 Ductile materials bear most stress than brittle materials.

Q. 13 $\text{Stress} = \frac{F}{A} = \frac{mg}{\pi \frac{d^2}{4}} = \frac{4mg}{\pi d^2}$

[illegible]

Q.15 [illegible]

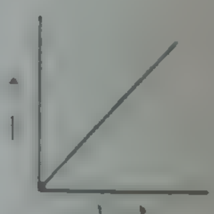
[illegible]

Q.16 Modulus of elasticity depends upon (i) nature of material (ii) temperature

Q.17 $\frac{\text{tensile stress}}{\text{tensile strain}}$ = young's modulus

Q.18 [illegible] is brittle in nature

Q.19



Area $= \frac{1}{2}(L)(x)$ = strain energy

Q.20

[illegible]

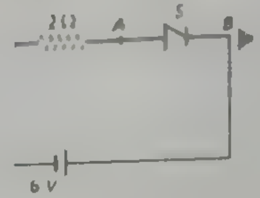
TOPIC-14 ELECTRONICS

PRACTICE EXERCISE

TOPIC-WISE MCQ's

HALF AND FULL WAVE RECTIFICATION

Q.1 The diode shown in the circuit is a silicon diode. The potential difference between the points A and B will be



A) 6 V
B) 0.6 V
C) 0.7 V
D) 0 V

Q.2 p-n junction when reversed biased acts as a ____________

A) Capacitor
B) Inductor
C) On switch
D) Off switch

Q.3 The branch of Physics which deals with the electrons and their flow through devices is called

A) Electronics
B) Electricity
C) Electrostatics
D) Electro magnetism

Q.4 The device which coverts A.C into D.C is called

A) Oscillator
B) Rectifier
C) Transducer
D) Diode

Q.5 By which process the depletion region is formed around the junction

A) Diffusion
B) Fusion
C) Emission
D) Fission

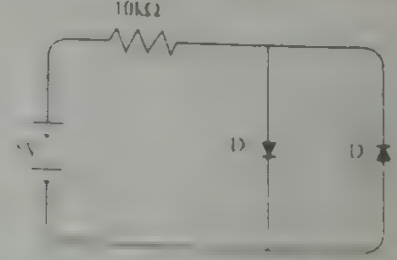
Q.6 The types of rectifications are

A) 3
B) 5
C) 4
D) 2

Q.7 Rectification is possible by

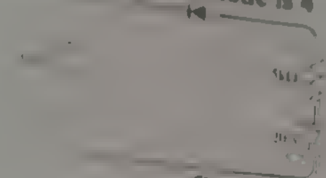
A) Transistor
B) Amplifier
C) Diode
D) Capacitor

Q.8 Assuming diodes D_1 and D_2 to be ideal, the current through them will be



A) $D_1 = 0$; $D_2 = 0.5mA$
B) $D_1 = 0.5mA$; $D_2 = 0$
C) $D_1 = 0.25mA$; $D_2 = 0.25mA$
D) None of the above

Q.9 If the maximum forward current rating of diode is 4 mA, then diode

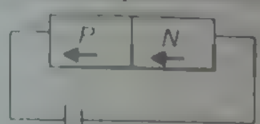


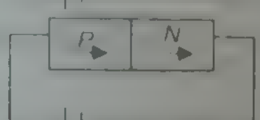
A) Is safe
B) Is not safe
C) May or may not be safe
D) None of the above

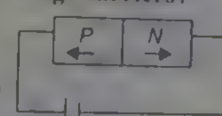
Q.10 What is the current in the circuit shown?

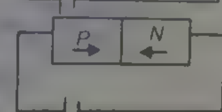
A) 0 A
B) 10^{-2} A
C) 1 A
D) 0.1 A

Q.11 In the case of forward biasing of pn junction, which one of the following figures correctly depicts the direction of the flow of charge carriers?

A) 

B) 

C) 

D) 

Q.12 Identify the correct statement about minority carriers-
A) Holes in n-type and free electrons in p-type
B) Free electrons in n-type and holes in p-type
C) Holes in n-type and p-type
D) Free electrons in n-type and p-type

Q.13 Forward current through a semi-conductor diode circuit is due to ________
A) Minority carriers
B) Holes
C) Majority carriers
D) Electrons

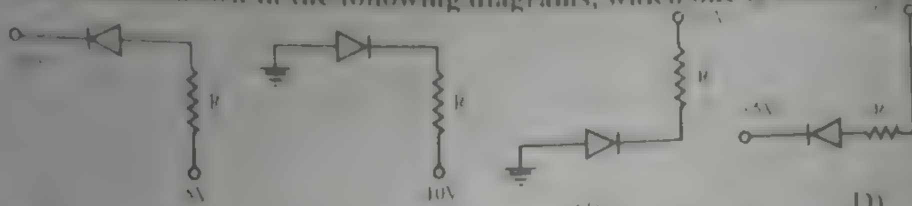
Q.14 The semiconductor diode can be used as a rectifier because ____________
A) It has low resistance to the current flow when forward biased & high resistance when reverse biased.
B) It has high resistance to the current flow when reverse biased
C) It has low resistance to the current flow when forward biased
D) Its conductivity increases with rise of temperature

Q.15 The number of valence electrons in silicon
A) 2
B) 4
C) 3
D) 6

Q.16 Which term refers to the region, where the two regions of the semiconductor meet
A) Anti-node
B) Loop
C) Junction
D) Depletion region

Q.17 In case of germanium, the value of potential barrier develops across the depletion region is
A) 0 V
B) 0.7 V
C) 0.9 V
D) 0.3 V

Q.18 The diodes shown in the following diagrams, which one is reverse biased



A) B) C) D)

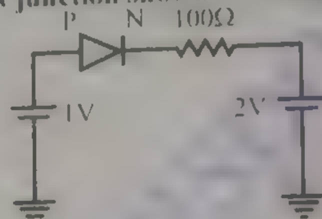
Q.19 Which one of the following is not an acceptor impurity?

A) aluminium
B) boron
C) iridium
D) gallium

Q.20 What type of material is formed when Pentavalent material is added to ... germanium?

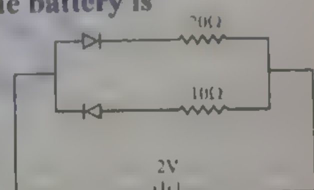
A) p-type
B) n-type
C) Both A & B
D) none of these

Q.21 The current through an ideal P-N junction shown in the following circuit diagram will be



A) zero
B) 10 mA
C) 1 mA
D) 30 mA

Q.22 In fig. the current supplied by the battery is

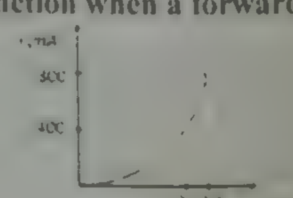


A) 0.1 A
B) 0.2 A
C) 0.3 A
D) 0.4 A

Q.23 In a P-N junction diode if P region is heavily doped than N region then the depletion layer is

A) Greater in P region
B) Greater in N region
C) Equal in both region
D) No depletion layer is formed in this case

Q.24 The i-V characteristic of a P-N junction diode is shown below. The approximate dynamic resistance of the P-N junction when a forward bias of 2volt is applied



A) 1 ohm
B) 0.25 ohm
C) 0.5 ohm
D) 5 ohm

Q.25 **The electrical resistance of depletion layer is large because**
A) It has no charge carriers
B) It has a large number of charge carriers
C) It contains electrons as charge carriers
D) It has holes as charge carriers

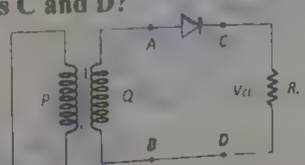
Q.26 **If no external voltage is applied across P-N junction, there would be**
A) No electric field across the junction
B) An electric field pointing from N-type to P-type side across the junction
C) An electric field pointing from P-type to N-type side across the junction
D) A temporary electric field during formation of P-N junction that would subsequently disappear

Q.27 **Barrier potential of a P-N junction diode does not depend on**
A) Temperature
B) Forward bias
C) Doping density
D) Diode design

Q.28 **No bias is applied to a P-N junction, then the current**
A) Is zero because the number of charge carriers flowing on both sides is same
B) Is zero because the charge carriers do not move
C) Is non-zero
D) None of these

SINGLE DIODE FOR HALF WAVE RECTIFICATION OF AN ALTERNATING CURRENT

Q.29 **In the half-wave rectifier circuit shown. Which one of the following wave forms is true for diode, the output across C and D?**



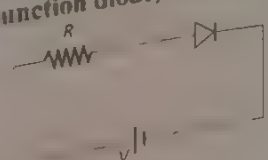

C)


A)


D)


B)

Q.30 **For the given circuit of PN-junction diode, which of the following statement is correct**



A) in forward biasing the voltage across R is 2V
B) in forward biasing the voltage across R is V
C) in reverse biasing the voltage across R is V
D) in reverse biasing the voltage across R is 2V

Q.31 The simplest type of rectification known as half wave rectification is obtained by ______

A) Using a transistor
B) Suppressing the harmonics in A.C voltage
C) Suppressing half wave of A.C supply by using diode
D) Using a Coolidge tube

Q.32 Output of half wave rectifier is suitable only

A) To operate radio
B) For running a D.C motor
C) Charging batteries
D) All of these

Q.33 During the interval $0 \rightarrow \frac{T}{2}$ the forward biased diode offers

A) very small resistance.
B) very small current flow through it
C) very high resistance
D) zero resistance

Q.34 In a half wave rectifier, the frequency of the input is N, the frequency and form of the output will be

A) N/2 and Pulsating
B) N and Pulsating
C) 2 N and steady
D) N and continuous

Q.35 The most common device used as filter is

A) Capacitor
B) Resistor
C) Transformer
D) Transistor

FOUR DIODES FOR FULL WAVE RECTIFICATION OF AN ALTERNATING CURRENT

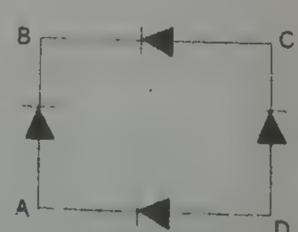
Q.36 In a bridge rectifier how, many diode conduct during each half cycle of input A.C

A) 2
B) 3
C) 1
D) All

Q.37 If a full wave rectifier circuit is operating from 50 Hz mains, the fundamental frequency in the ripple will be

A) 50 Hz
B) 100 Hz
C) 70.7 Hz
D) 25 Hz

Q.38 In figure the input is across the terminals A and C and the output is across B and D. Then the output is



A) half wave rectified
B) zero
C) full wave rectified
D) same as input

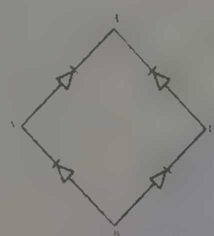
Q.39 To reduce ripples in the output of bridge rectifier we should use

A) Diode having low forward resistance
B) Diode having high forward resistance
C) Low frequency A.C
D) A filter circuit

Q.40 **In full wave rectification, the output D.C. voltage across the load is obtained for** ______

A) The positive half cycle of input A.C.
B) The negative half cycle of input A.C.
C) The complete cycle of input A.C.
D) All of the above.

Q.41 **In the diagram; the input is across the terminals A and C and the output is across the terminals B and D, then the output is**



A) zero
B) full wave rectifier
C) same as input
D) half wave rectifier

OPERATIONAL AMPLIFIER AND ITS CHARACTERISTICS

Q.42 **An open loop op-amplifier has output voltage V_o and difference between non-inverting and inverting input voltage V_i. Its open loop is given by:**

A) $A_{OL} = \frac{V_o}{Vi}$
B) $A_{OL} = V_o \times Vi$
C) $A_{OL} = \frac{Vi}{V_o}$
D) None of the two

Q.43 **The op-amp can amplify**

A) A.C signals only
B) Both A.C and D.C signals
C) D.C signals only
D) neither D.C nor A.C signals

Q.44 **OP-Amp gives output voltage ______ and with phase difference of?**

A) Amplified, π
B) Amplified, $\frac{\pi}{2}$
C) Amplified, 0
D) Both A and C

Q.45 **Open loop gain of op-Amp is in order of**

A) 10^3
B) 10^5
C) 10^2
D) 10^1

Q.46 The ideal OP-AMP has the following characteristics.

A) $R_{input} = \infty$, $R_{output} = 0$
B) $R_{input} = \infty$, $A = \infty$, $R_o = \infty$
C) $R_{input} = 0$, $R_{output} = 0$
D) $R_{input} = 0$, $R_{output} = \infty$

Q.47 Input resistance of operational amplifier is

A) Very low
B) Very high
C) Infinity
D) Zero

Q.48 Operational amplifier works with open loop potential difference between input terminals is 150 μV. The out voltage is

A) 50 V
B) 15 V
C) 100 V
D) 150 V

Q.49 For an operational amplifier the output resistance is the resistance between

A) inverting input and ground terminal
B) non inverting input and ground
C) output terminal and ground
D) Input and output terminal

Q.50 With zero volts on both inputs, an OP-amp ideally should have an output ....

A) equal to the positive supply voltage
B) equal to zero
C) equal to the negative supply voltage
D) equal to CMRR

ANSWER KEY

1	A	11	D	21	A	31	C	41	B
2	D	12	A	22	B	32	C	42	A
3	A	13	C	23	B	33	A	43	B
4	B	14	A	24	B	34	B	44	D
5	A	15	B	25	A	35	A	45	B
6	D	16	C	26	B	36	A	46	A
7	C	17	D	27	D	37	B	47	B
8	A	18	C	28	B	38	C	48	B
9	A	19	C	29	D	39	D	49	C
10	A	20	B	30	B	40	C	50	B

EXPLANATORY NOTES

Q.1 In the given condition diode is in reverse biasing so it acts as open circuit. Hence potential difference between A and B is 6V

Q.2 In reversed biasing

$I \approx 0$

Ordinary circuits:

When switch is OFF, current is zero

Q.3 By definition.

Q.4 Definition of rectifier.

Q.5 Some electrons diffuse to the p-region. So, process is diffusion

Q.6 Two

Q.7 Diode is used as rectifier.

Q.8 The current through diode D_1 is zero because it is reverse biased. However, diode D is forward biased and current through it is $= \frac{5V}{10k\Omega} = 0.5 \times 10^{-3} A = 0.5 mA$

Q.9 Current in 5 kΩ resistor $= \frac{(20-10)V}{5k\Omega} = \frac{10V}{5k\Omega} = 2mA$

The diode is safe because the current it carries (i.e., 2mA) is less than the maximum forward current rating of diode (i.e., 4 mA)

Q.10 (1 V is high voltage w.r.t −4 V) Since the diode is reverse biased, the circuit current is zero

Q.11 Holes move along electric field and electron in opposite direction.

Q.12 Holes in n-type semi-conductor and free electrons in p-type semi-conductor are minority charge carriers.

Q.13 Forward current through a semi-conductor diode circuit is due to majority carriers.

Q.14 Its reverse biased resistance is very high in order of M Ω and forward biased resistance is very low in order of few ohms.

Q.15 The number of valence electrons in silicon 4.

Q.16 At junction, the two regions of the semiconductor meet.

Q.17 For germanium, the value of potential barrier is 0.3V.

Q.18 When external source of voltage is applied across a p-n junction such that its high potential is connected to n-region and its low potential to p-region, the p-n junction is said to be reverse biased.

Q.19 All these belong to 3rd group accept iridium which belongs to VIII-B

Q.20 N-type semi-conductor is formed by doping on intrinsic semi conductor by a penta... impurity.

Q.21 It is reverse biasing, in reverse biasing current flow is approximately zero

Q.22 $I = \frac{V}{R} = \frac{2}{10} = 0.2A$

Q.23 Depletion layer is more in less doped side.

Q.24 The current at 2V is 400 mA and at 2.1 V it is 800 mA. The dynamic resistance in this...

$$R = \frac{\Delta V}{\Delta i} = \frac{(2.1-2)}{(800-400)\times 10^{-3}} = \frac{1}{4} = 0.25\Omega$$

Q.25 Depletion layer consist of mainly stationary ions.

Q.26 Across the P -N junction, a barrier potential is developed whose direction is from N region to P region.

Q.27 Barrier potential of a P-N junction diode depend on temperature, forward by biasing dop... density and independent of diode design.

Q.28 In unbiased condition of PN-junction, depletion region is generated which stops movement of charge carriers.

Q.29 Half wave rectifier, rectifies only the half cycle of input ac signal and it blocks the other h...

Q.30 In forward biasing, resistance of PN junction diode is zero, so whole voltage appears ac... the resistance.

Q.31 PN junction has low resistance in one direction of potential difference +V, so a large cu... flows (forward biasing). It has a high resistance in the opposite potential difference dir... V, so a very small current flows (Reverse biasing)

Q.32 Output voltage of half wave rectifier is pulsating, when it made smooth by filter. voltage is decrease this low voltage suitable for charging batteries.

Q.33 Forward biased diodes has low resistance.

Q.34 In half wave rectifier

- Input frequency = output frequency
- Output wave is pulsating

Q.35 Filters made output smooth

Q.36 In a bridge rectifier two diodes in forward biased and conduct in each half cycle

Q.37 In full wave rectifier, frequency of output wave is double of input wave

Q.38 It is the diagram of full wave bridge rectifier circuit.

Q.39 We use capacitor as filter circuit.

Q.40 Direction of current flow through the load resistance R is the same in both halves cycles of input wave.

Q.41 Full wave rectifier circuit

Q.42 $\dfrac{V_o}{V_i}$

Q.43 OP-AMP can amplify both A.C and D.C signal

Q.44 Op-Amp may be inverting or non-inverting.

Q.45 Open loop gain of an op-amp is of the order of 10^5.

Q.46 For ideal op-amp

$$I_{in} = \frac{V}{R_{in}} = \frac{V}{\infty} = 0A \text{ and } I_{output} = \frac{V}{R_{out}} = \frac{V}{0} = \infty A$$

Q.47 Due to high value of input resistance no current flows between the two input terminals of op-amp.

Q.48 $A_{OL} = \dfrac{V_o}{V_+ - V_-} = \dfrac{V_o}{V_i}$

$$V_o = A_{OL} \times V_i = 10^5 \times 150 \times 10^{-6} \Rightarrow \boxed{V_o = 15\ V}$$

Q.49 Output resistance is the resistance between output terminal and ground

Q.50 For ideal amplifier: Input voltage = output voltage

PAST PAPER MCQ's (2008-2019)

2008

Q.1 An n-type semi-conductor is made by doping silicon crystal with ________:

A) Indium
B) Aluminium
C) Arsenic
D) Both B and C

2009

Q.2 A signal that is applied at the inverting input terminal of an op-amplifier underg amplification, at the output terminal with a phase shift of:

A) 0°
B) 270°
C) 360°
D) 180°

Q.3 To convert the Si crystal into p-type semi-conductor, which group element will be doped:

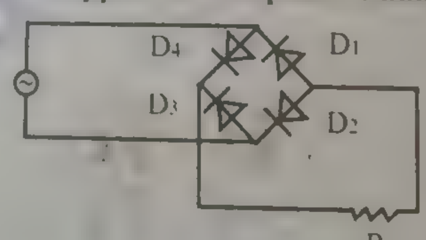
A) Trivalent Element
B) Second Group Element
C) Fourth Group Element
D) Pentavalent Element

2017

Q.4 Output voltage of rectifier is not smooth. It can be made smooth by using a circuit known as:

A) Wheat stone circuit
B) Bridge circuit
C) Ripple circuit
D) Filter circuit

Q.5 In the following figure what happens for the positive half cycle of the input?



A) D_1 and D_3 conducts
B) D_1 and D_2 conducts
C) D_4 and D_2 conducts
D) D_4 and D_3 conducts

Retake 2017

Q.6 When we apply input at the non-inverting input of an operational amplifier the output appears after:

A) Amplification, phase shift of 180°
B) Amplification, phase shift of 60°
C) Amplification, no phase shift
D) None of these

Q.7 For an LED what is true?

A) It is always forward biased

B) It releases a photon when covalent bonds breaks

C) It releases photon when electron combines with hole

D) Both "A" & "C"

2018

Q.8 In case of half wave rectification, resistance of diode during negative half of A.C is:

A) very high

B) very low

C) a few ohms

D) negive

2019

Q.9 A negligible small current between input terminals of the operational amplifier is because of:

A) low input resistance

B) low output resistance

C) high output resistance

D) high input resistance

Q.10 The direction of current through the load resistance of a full-wave rectification circuit:

A) inverts for negative cycle

B) changes for every cycle

C) inverts for positive cycle

D) remains constant

ANSWER KEY

[illegible]	C	[illegible]	C
[illegible]	D	[illegible]	D
[illegible]	A	[illegible]	A
[illegible]	D	[illegible]	D
[illegible]	C	[illegible]	D

EXPLANATORY NOTES

Q.1 An n type semiconductor is made by doping silicon crystal with Arsenic (Group v)

Q.2 A signal that is applied at the inverting input terminal of an op-amplifier undergo amplification, at output terminal with phase shift of 180°.

Q.3 For P type, semiconductor, Si-crystal will be doped with trivalent element.

Q.4 Output voltage of rectifier is not smooth. It can be made smooth by using a circuit known as filter circuit.

Q.5 During the positive half-cycle the diodes D_2 and D_4 are forward biased and diodes D_1 and D are reversed biased.

Q.6 When input supply is given to non-inverting amplifier, only amplification takes place with no phase shift.

Q.7 LED is forward biased p-n junction and it releases photon when electron combines with holes

Q.8 In case of half rectification, resistance of diode during negative half of A.C is very high.

Q.9 A negligible small current between input terminals of the operational amplifier is because of high input resistance.

Q.10 In full wave rectification circuit, direction of current through load resistance remains same during +ve & -ve half cycles.

MODERN PHYSICS

PRACTICE EXERCISE

TOPIC-WISE MCQ's

ENERGY OF PHOTON E = hf

Q.1 **Photon of highest frequency will be absorbed when transition takes place from ________.**

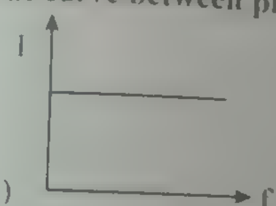
A) 1^{st} to 5^{th} orbit
B) 2^{nd} to 5^{th} orbit
C) 3^{rd} to 5^{th} orbit
D) 4^{th} to 5^{th} orbit

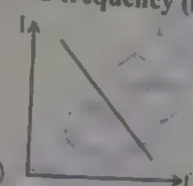
Q.2 **The value and units of the Plank's constant 'h' can be expressed as:**

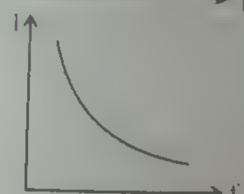
A) 6.63×10^{-34} Js^{-1}
B) 6.63×10^{-43} Js
C) 6.63×10^{-34} Js
D) 3.63×10^{-34} Js

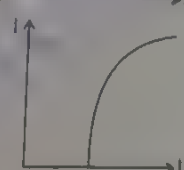
PHOTOELECTRIC EFFECT, THRESHOLD FREQUENCY AND WORK FUNCTION ENERGY

Q.3 **The curve between photoelectric current (I) and frequency (f) is**

A) 

C) 

B) 

D) 

Q.4 **The reverse process of photo electric effect is**

A) annihilation of matter
B) pair production
C) production of X-rays
D) nuclear fission

Q.5 **If the wavelength of incident radiation in a photoelectric experiment is decreased then**

A) the photoelectric current will decrease
B) the photoelectric current will increase
C) the stopping potential will decrease
D) the stopping potential will increase

Q.6 **A photoelectric cell is illuminated by a point source of light 1m away. When the source is taken 2m away**

A) The number of electrons emitted is a quarter of the initial number
B) The number of electrons emitted is half the initial number
C) Each electron emitted carries one quarter of initial energy
D) Each emitted electron carries half the initial energy

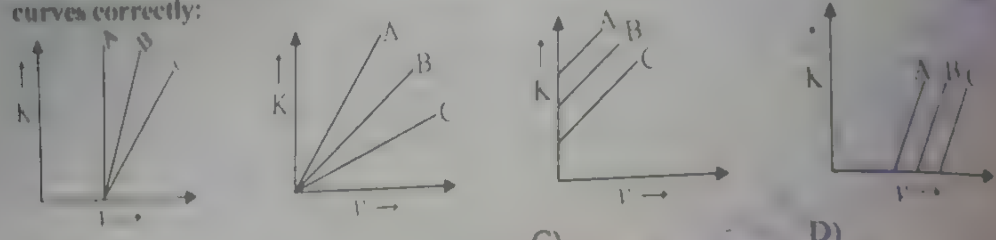
Q.7 **In a photoelectric effect experiment the stopping potential is:**

A) The electric potential that causes the electronic current to vanish
B) The photon energy
C) The kinetic energy of the most energetic electron ejected
D) The energy required to remove an electron from the sample

Q.8 Stopping potential for a metal surface in case of photoelectric emission depends on

A) The threshold frequency for the metal surface
B) The intensity of incident light
C) The frequency of incident light and work function of the metal surface
D) All of the above

Q.9 For three different metals A, B, C photo-emission is observed one by one and maximum kinetic energy (K) versus frequency (ν) of incident light graphs are plotted. Which fig. represents the curves correctly:



A) B) C) D)

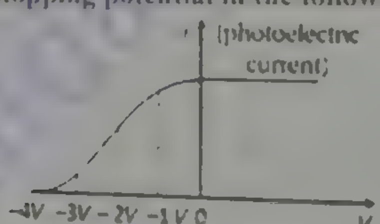
Q.10 The work function of a metallic substance is 5 eV. Then threshold frequency is approximately

A) 1.6×10^{7} Hz
B) 8.68×10^{15} Hz
C) 9.68×10^{17} Hz
D) 1.2×10^{15} Hz

Q.11 An ultraviolet light source causes the emission of photoelectrons from a zinc plate. A more intense source of the same wavelength would give

	Maximum energy / electron	No. of electrons / second
A)	more	the same
B)	the same	more
C)	the same	the same
D)	more	more

Q.12 The value of stopping potential in the following diagram



A) 2 V
B) −4 V
C) −3 V
D) −1 V

Q.13 In a photoelectric effect experiment at a frequency above threshold frequency, number of electrons ejected is proportional to

A) The frequency of the incident light
B) Their potential energy
C) The number of photons that hit the sample
D) Their kinetic energy

During Einstein's Photoelectric Experiment, what changes are observed when the frequency of the incident radiation is increased?

A) The saturation current increases

B) No effect

C) The value of stopping potential increases

D) The value of stopping potential decreases

Q.15 How does the intensity affect the photoelectric current?

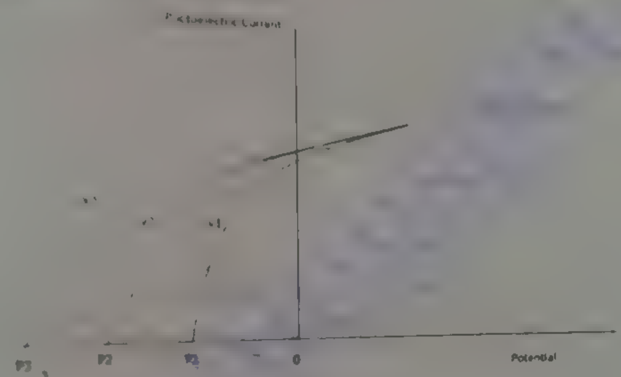
A) As intensity increases, the photoelectric current increases

B) As the intensity increases, the photoelectric current decreases

C) As the intensity decreases, the photoelectric current becomes twice

D) No effect

Q.16 Identify the correct order of frequencies.



A) $v_1 > v_2 > v_3$

B) $v_2 > v_3 > v_1$

C) $v_3 > v_2 > v_1$

D) $v_1 > v_3 > v_2$

Q.17 What is the effect of intensity on the stopping potential?

A) As intensity increases, stopping potential increases linearly

B) As intensity increases, stopping potential decreases linearly

C) As intensity decreases, stopping potential increases exponentially

D) No effect

MAXIMUM PHOTOELECTRIC ENERGY IS INDEPENDENT OF INTENSITY WHEREAS PHOTOELECTRIC CURRENT IS PROPORTIONAL TO INTENSITY

Q.18 The maximum energy of the electrons released in a photo cell is independent of

A) frequency of incident light

B) intensity of incident light

C) nature of cathode rays

D) none of these

Q.19 Light of frequency 1.5 times the threshold frequency is incident on a photo sensitive material. If the frequency is halved and intensity is doubled the photo electric current becomes

A) four times

B) double

C) half

D) zero

Q.20 If the intensity of incident light is made double, then the maximum number of emitted electrons will become

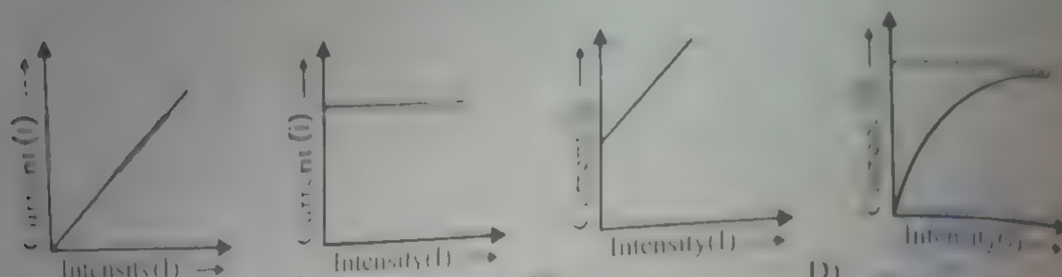
A) double

B) eight times

C) four times

D) half

Q.21 Which one of the following graphs represents correctly the variation of photoelectric current (I) with intensity (I) of incident radiations?



A) B) C) D)

EINSTEIN'S PHOTOELECTRIC EQUATION $hf = \phi + \frac{1}{2}mv^2_{max}$

Q.22 Einstein's photoelectric equation is

A) $\frac{1}{2}mv^2_{max} = hf$

B) $\frac{1}{2}mv^2 = hf - \phi$

C) $\frac{1}{2}mv^2_{max} = \phi$

D) $\frac{1}{2}mv^2_{max} = hf - \phi$

Q.23 Two photons of energy 2.5 eV each are incident on a metal plate whose work function is 4.0 eV, then the number of electrons emitted from the metal surface will be.

A) One
B) More than two
C) Two
D) Electron emission is not possible

Q.24 $(K.E.)_{max} = hf - hf_o$ is known as:

A) Compton equation
B) Planks equation
C) Newton's equation
D) Photoelectric equation

Q.25 The threshold wavelength for a metal whose work function is W_0 is λ_0. What is the threshold wavelength for a metal whose work function is $W_0/2$?

A) $\frac{\lambda_0}{4}$

B) $\frac{\lambda_0}{2}$

C) $2\lambda_0$

D) $4\lambda_0$

DE BROGLIE WAVELENGTH AND USE $\lambda = \frac{h}{p}$

Q.26 If the K.E of a free electron doubles then its de-Broglie wavelength changes by a factor

A) $\frac{1}{2}$

B) $\frac{1}{\sqrt{2}}$

C) 2

D) $\sqrt{2}$

Q.27 Photon A has twice the energy of photon B. What is the ratio of the momentum of A to that of B?

A) 2 : 1
B) 1 : 1
C) 1 : 2
D) none of these

Q.28 If [illegible] are the respective kinetic energies of an electron, an alpha-particle and a proton, each having the same de-Brogile wavelength then

A) $E_1 > E_3 > E_2$

B) [illegible]

C) $E_2 > E_3 > E_1$

D) $E_1 = E_2 = E_3$

Q.29 The magnitude of de-Brogile wavelength (λ) of electrons (e), proton (p), neutron (n), and α particles all have the same energy 1 MeV, in increasing order will follow the sequence.

A) [illegible]

B) [illegible]

C) $\lambda_e, \lambda_p, \lambda_n, \lambda_\alpha$

D) $\lambda_\alpha, \lambda_p, \lambda_n, \lambda_e$

Q.30 The wavelength of matter waves is independent of:

A) Mass

B) Momentum

C) Velocity

D) Charge

Q.31 Of the following moving with same momentum, the one which has largest wavelength is:

A) An electron

B) A proton

C) An α-particle

D) All have same de-Broglie wavelength

Q.32 A particle of mass M at rest decays into two masses m_1 and m_2 with non-zero velocities. The ratio of de-Broglie wave lengths of the particles $\frac{\lambda_1}{\lambda_2}$ is

A) $\frac{m_2}{m_1}$

B) $\frac{\sqrt{m_1}}{\sqrt{m_2}}$

C) $\frac{m_1}{m_2}$

D) 1 : 1

DISCRETE ENERGY LEVELS OF HYDROGEN ATOM AND SPECTRAL LINES

Q.33 Lyman series of H-atom lie in the ______ region of EM spectrum

A) visible

B) infrared

C) ultraviolet

D) red

Q.34 The prominent lines of the Balmer series lie in

A) visible

B) infrared

C) ultraviolet

D) red

Q.35 In Bohr's model of H-atom the angular momentum is

A) h

B) $n\frac{h}{2\pi}$

C) $2\pi r$

D) none of these

Q.36 When electron jumps from n^{th} to the p^{th} orbit in an hydrogen atom then the wavelength of the emitted radiation is given by

A) $\frac{1}{\lambda} = R_H\left[\frac{1}{p^2} - \frac{1}{n^2}\right]$

B) $\frac{1}{\lambda} = \frac{1}{R_H}\left[\frac{1}{p^2} - \frac{1}{n^2}\right]$

C) $\frac{1}{\lambda} = R_H\left[\frac{1}{n^2} - \frac{1}{p^2}\right]$

D) $\frac{1}{\lambda} = \frac{1}{R_H}\left[\frac{1}{4^2} - \frac{1}{n^2}\right]$

Q.37 An expression for electrostatic force between the electron and the nucleus of hydrogen atom is given by:

A) [illegible]

B) [illegible]

C) $F_e = K\frac{Ke^2}{r^2}$

D) $F_e = K\frac{ke}{r}$

Q.38 **In the state $n = \infty$ of hydrogen atom, total energy of electron is:**
A) 5.2 eV
B) 9.8 eV
C) Zero
D) 10.5 eV

Q.39 **The hydrogen atoms are excited to the stationary state designated by the principal quantum number n = 4. The number of maximum spectral lines are observe**
A) 2
B) 3
C) 4
D) 6

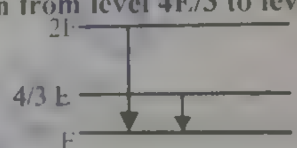
Q.40 **The ratio of the energies of the hydrogen atom in the first and the second excited states is**
A) 1 : 4
B) 4 : 1
C) 4 : 9
D) 9 : 4

Q.41 **With increasing quantum number the energy difference between adjacent levels in atoms**
A) decreases
B) increases
C) decreases for low Z and increase for high Z atoms
D) remains constant

Q.42 **In Bohr model of hydrogen atom, let PE represent potential energy and TE the total energy. In going to a higher level:**
A) PE decreases, TE increases
B) PE increases, TE decreases
C) PE decreases, TE decreases
D) PE increases, TE increases

RELATION $hf = (E_2 - E_1)$

Q.43 **The following fig indicates the energy levels of a certain atom. When the system moves from 2E level to E a photon of wavelength λ is emitted. The wavelength of photon produced during its transition from level 4E/3 to level E is.**



A) $\frac{\lambda}{3}$
B) $\frac{3\lambda}{4}$
C) $\frac{4\lambda}{3}$
D) 3λ

PRODUCTION OF X-RAYS AND FEATURES OF X-RAYS TUBE

Q.44 **Maximum speed of electrons in X-rays tube which is producing X-rays photons of frequency f is**
A) $\frac{hf}{m}$
B) $\frac{2hf}{m}$
C) $\sqrt{\frac{2hf}{m}}$
D) $\sqrt{\frac{hf}{m}}$

Q.45 **The kinetic energy K.E. with which the electron strikes the target is given by:**
A) K.E. = e^2V
B) K.E. = hc/2
C) K.E. = hf^2
D) K.E. = eV

Q.46 **The wavelength range of X-rays is**
A) 1 mm to 700 nm
B) 400 nm to 1 nm
C) 1 nm to 0.001 nm
D) 0.1 m to 1 mm

Q.47 X-rays crystallography uses which characteristic of light?

A) [illegible]
B) [illegible]
C) Diffraction
D) Coherency

Q.48 **In the X-rays production, let λ_c be the cut off wavelength, λ_α be the wavelength of K-alpha line and λ_β be wavelength of K-beta line, then**

A) [illegible]
B) [illegible]
C) $\lambda_\alpha > \lambda_c > \lambda_\beta$
D) $\lambda_\beta > \lambda_c > \lambda_\alpha$

Q.49 **X-rays are produced by applying potential difference of 40 KV. Find minimum wavelength produced**

A) 3.3×10^{-10} m
B) 3.3×10^{-12} m
C) 0.3×10^{-10} m
D) 3.3×10^{-6} m

Q.50 **The ratio of speed of γ-rays and X-rays is:**

A) 1
B) <1
C) >1
D) None of these

ANSWER KEY

1	A	11	B	21	A	31	D	41	A
2	C	12	B	22	D	32	D	42	D
3	A	13	C	23	D	33	C	43	D
4	C	14	C	24	D	34	A	44	C
5	D	15	A	25	C	35	B	45	D
6	A	16	C	26	B	36	A	46	C
7	A	17	D	27	A	37	A	47	C
8	C	18	B	28	A	38	C	48	B
9	D	19	D	29	C	39	D	49	C
10	D	20	A	30	D	40	D	50	A

EXPLANATORY NOTES

Q.1 If energy gap is maximum then energy required will also be maximum.

Q.2 $h = 6.63 \times 10^{-34}$ J.s

Q.3 Photoelectric current does not depend upon frequency of photon.

Q.4 In photoelectric effect photons produce electrons. But in X-ray production electron produce photons.

Q.5 Stopping potential $\propto f$ So, $V_o \propto \frac{1}{\lambda}$

Q.6 Intensity $\propto \frac{1}{(\text{distance})^2} \propto$ No of electrons

If distance from source becomes double then intensity of light and number of emitted electrons reduce to one fourth.

Q.7 Stopping potential is applied to stop photoelectrons to vanish photo electric current

Q.8 As, $hf = \phi + (K.E)_{max} \Rightarrow hf = \phi + eV_o$ Hence $eV_o = hf - \phi$

So stopping potential depends upon incident frequency and work function of metal.

Q.9 After the threshold frequency

$(K.E)_e \propto$ Frequency of incident light.

Q.10 $\phi = hf_o \Rightarrow f_o = \frac{5(1.6 \times 10^{-19})}{6.63 \times 10^{-34}} \Rightarrow f_o = 1.2 \times 10^{15}$ Hz

Q.11

- Intensity $\propto$ number of electrons
- $K.E_{max} \propto f \propto \frac{1}{\lambda}$

Q.12 Stopping potential is that negative potential for which photo electric current is zero

Q.13 No of electrons ejected $\propto$ intensity of light (No of photons)

Q.14 As the frequency of the incident radiation increases, the kinetic energies of the emitted electron increase as well and therefore requires more repulsive force to be applied to stop them. Thus, the stopping potential increases.

The value of saturation current increases, as the intensity of the incident radiation increases.

The value of stopping potential decreases, as the frequency decreases

Q.15 Since each incident photon ejects one photoelectron from a metal surface, therefore the number of photoelectrons emitted depends on the number of photons falling on the metal surface, which in turn depends on the intensity of the incident light. Hence, as the intensity increases, the number of photoelectrons ejected increases and photoelectric current increases.

Q.16 As the frequency of the incident light increases, the potential required to stop them (stopping potential) increases. Hence, $v_3 > v_2 > v_1$.

The stopping potential varies linearly with the frequency of the incident light.

Q.17 ... intensity of incident radiation does not affect the stopping potential. As the intensity increases, the number of photoelectrons ejected increases. However, the maximum ... attained by them remains independent of the intensity of the radiation. It only depends on the frequency of the incident radiation.

Q.18 Kinetic energy of photo electrons does not depend upon intensity of light but it depends upon energy (frequency) of photons.

Q.19 When the frequency of light is less than threshold frequency then no photo electron will be emitted hence photo electric current will be zero

Q.20 Intensity $\propto$ No of electrons

Q.21 $I \propto$ Intensity of incident light

Q.22 $E_{incident} = \phi + K.E \Rightarrow \frac{1}{2}mv^2 = hf - \phi$

Q.23 Here incident energy of photon < work function
So, photoelectric effect will not start.

Q.24 Photoelectric equation is
$hf = hf_o + (K.E)_{max}$

Q.25 $\phi = hf_o \Rightarrow W_o = hf_o = \frac{hc}{\lambda_o} \Rightarrow \boxed{W_o \propto \frac{1}{\lambda_o}}$

If work, function of a metal reduces to half then wavelength becomes double.

Q.26 $\lambda = \frac{h}{\sqrt{2mE}} \Rightarrow \lambda \propto \frac{1}{\sqrt{E}}$

Q.27 $E = pc \Rightarrow E \propto p$

$\frac{p_A}{p_B} = \frac{E_A}{E_B} \Rightarrow \frac{p_A}{p_B} = \frac{2E_B}{E_B} = 2:1$

Q.28 $\lambda = \frac{h}{\sqrt{2mE}} \Rightarrow m \propto \frac{1}{E}$

$m_\alpha > m_p > m_e \Rightarrow E_\alpha < E_p < E_e$ Hence $E_2 < E_3 < E_1$

Q.29 $\lambda = \frac{h}{\sqrt{2m K.E}} \Rightarrow \lambda \propto \frac{1}{\sqrt{m}}$ Hence sequence is; $\lambda_\alpha, \lambda_n, \lambda_p, \lambda_e$

Q.30 $\lambda = \frac{h}{mv} = \frac{h}{p}$ So, wavelength does not depend upon charge.

Q.31 $\lambda = \frac{h}{p}$ As h is constant and p is same. So, all particles have same wavelength.

Q.32 Here $0 \times M = m_1v_1 + m_2v_2$. Clearly, $m_1v_1 = -m_2v_2$
In magnitude, $mv = \text{constant}$ $\therefore \lambda = \frac{h}{p} \Rightarrow \frac{\lambda_1}{\lambda_2} = \frac{1}{1}$

Q.33 Lyman series lies in UV region, having max energy difference w.r.t other transitions.

Q.34 Balmer series lies in visible spectrum.

Q.35 ... momentum is $\frac{h}{mv}$ ... $\frac{h}{n}$ ...

Q.36 According to Rydberg. $\frac{1}{\lambda} = R_H\left(\frac{1}{P^2} - \frac{1}{n^2}\right)$

Q.37 For Hydrogen atom $Q_1 = e^+$ $Q_2 = e$

So, $F = \frac{KQ_1Q_2}{r^2} = \frac{Ke^2}{r^2}$

Q.38 $n = \infty$ As, $E_n = -\frac{E_o}{n^2} = 0$

Q.39 No of spectral lines $= \frac{n(n-1)}{2}$ Here n = 4,

Q.40 $E_n = \frac{-E_o}{n^2} \Rightarrow E_n \propto \frac{-1}{n^2}$

$\frac{E_1}{E_2} = \left(\frac{n_2}{n_1}\right)^2 = \left(\frac{3}{2}\right)^2 = \frac{9}{4}$

Q.41 $E_n \propto \frac{1}{n^2}$

Q.42 $P.E = \frac{-Ke^2}{r_n}$ and $T.E = \frac{-Ke^2}{2r_n}$

Q.43 $\lambda = \frac{hc}{E_2 - E_1} = \frac{hc}{2E - E} = \frac{hc}{E}$

$\lambda' = \frac{hc}{E_2' - E_1'} = \frac{hc}{\frac{4E}{3} - E} = \frac{3hc}{E} = 3\lambda \quad \because \lambda = \frac{hc}{E}$

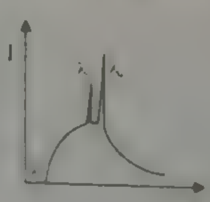
Q.44 $\frac{1}{2}mv^2 = hf \Rightarrow v = \sqrt{\frac{2hf}{m}}$

Q.45 The energy of electron with which it hit the target material is K.E = eV

Q.46 X-ray lies beyond the UV region of the electromagnetic spectrum. Its wavelength ranges from 1 nm to 0.001 nm. Beyond X-rays lies Gamma rays

Q.47 X-ray crystallography is used to identify the molecular and atomic structure of the crystal. The crystal diffracts the incident X-ray beam. By measuring the intensities and angles of diffracted beams, the molecular structure of the crystal can be evaluated.

Q.48



From the diagram it is clear that

$\lambda_c < \lambda_\beta < \lambda_\alpha$ or $\lambda_\alpha > \lambda_\beta > \lambda_c$

Q.49 $\lambda_{min} = \frac{1240\ nm}{V} = \frac{1240\times10^{-9}}{40\times1000} m = \frac{1.24}{4}\times10^{-10}\ m = 0.31\times10^{-10}\ m$

Q.50 All E.M waves have $c = 3\times10^8\ ms^{-1}$ in vacuum.

PAST PAPER MCQ's (2008-2019)

2008

Q.1 Cesium coated oxidized silver emits electrons for ________ light.

A) Infrared
B) Ultraviolet
C) Visible
D) Green

Q.2 In photoelectric effect removal of photons is observed at ________ energies.

A) Low
B) High
C) Intermediate
D) Both A and C

2009

Q.3 Einstein's photoelectric equation is given by:

A) $hf = \phi + \frac{1}{2} mv^2$
B) $E = mc^2$
C) $E = hc^{2\cdot}$
D) $hf = \frac{1}{2} mv^2$

Q.4 A crack allows greater amount of X-rays to pass, which appears on photographic film as:

A) Blue Area
B) Dark Area
C) Bright Area
D) Red Area

2010

Q.5 The minimum frequency below which no electron is emitted from the metal surface is called:

A) High frequency
B) Low frequency
C) Threshold frequency
D) Resonance frequency

Q.6 Velocity of electron moving in first orbit of hydrogen is:

A) 2.19×10^7 m/sec
B) 2.18×10^7 m/sec
C) 2.2×10^6 m/sec
D) 2.19×10^6 m/sec

2011

Q.7 Wavelength of X-rays is the order of:

A) 10^{-6} m
B) 10^{-10} m
C) 10^{-13} m
D) 100 m

Q.8 The characteristic X-ray spectrum is due to:

A) The absorption of neutrons by target material
B) The bombardment of target material by protons
C) The bombardment of target material by electrons
D) The bombardment of target material by alpha particles

2012

Q.9 The kinetic energy K.E. with which the electron strikes the target is given by:

A) K.E. = eV
B) K.E. = hc/2
C) K.E. = hf
D) K.E. = eV

Q.10 X-rays can be produced by bombardment of ________ on target metal:

A) Protons
B) Electrons
C) Neutron
D) Alpha particles

Q.11 If an electron in the 'K' shell is removed and an electron from 'L' shell jumps to occupy the hole in the 'K' shell, it emits a photon of energy.

A) $hf_{K\alpha} = E_{K\alpha} - E_L$
B) $hc = E - E$
C) $hf_{K\alpha} = E_L - E_K$
D) $hf = E_L - E_K$

Q.12 Which of the following property must be there in a substance so that it can be used as target in X-ray tube?

... point

... number

C) It must have high reflecting ability

D) It must have high atomic number

2013

Q.13 X-rays from a given X-ray tube operating under specified conditions have a minimum wavelength. The value of this minimum wavelength could be reduced by:

A) ... the target

B) Increasing the potential difference between the cathode and the target

C) Reducing the temperature of the filament

D) Reducing the pressure in the tube

Q.14 What is the type of characteristics X-ray photon whose energy is given by relation '$hf = E_M - E_K$'?

A) K – alpha

B) M – alpha

C) K – beta

D) M – beta

Q.15 For what CAT stands in X-ray technology?

A) Capacitor Amplifier Transition

B) Computerized Axial Tomography

C) Cathode Anode Technique

D) Current Amplification Transistor

Q.16 Kinetic energy of electrons by applying potential difference V_1 across the X-ray tube is KE_1 while V_2 potential difference produces kinetic energy equal to KE_2. What will be value of $KE_1 : KE_2$ if ratio of potential difference $V_1 : V_2 = 2:3$?

A) 3:2

B) 4:9

C) 9:4

D) 2:3

Q.17 What will be the relation for the speed of electron accelerated towards the target in X-ray tube by applying potential difference 'V'; take mass of electron 'm' and charge on electron 'e'?

A) $v = \sqrt{2Ve/m}$

B) $v = \sqrt{2me/V}$

C) $v = \sqrt{2V/me}$

D) $v = \sqrt{2meV}$

2014

Q.18 What will be the energy of accelerated electron used to produce X-rays accelerating potential is 2KV?

A) 2×10^{10}

B) 1.6×10^{19}

C) 3.2×10^{-16}

D) 3.2×10^{18}

2015

Q.19 In X-ray tube, electrons after being accelerated through potential 'V' strike the target then the wavelength of emitted X-rays is:

A) Not greater than $\frac{hc}{eV}$

B) Not less than $\frac{hc}{eV}$

C) Equal to $\frac{h}{mV}$

D) equal to $\frac{hc}{eV}$

Q.20 In the case when the electrons lose all their kinetic energy (K.E) in the first collision, X-ray photon emitted has which of the following set of frequency and wavelength?

A)

B)

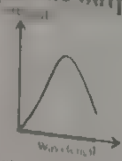
C)

D)

Q21 The potential difference between target and cathode of an X-rays tube is 20 KV and current is 20 mA. What is the λ_{min} of the emitted X-ray?

[illegible] $10^{-?}$ m
[illegible] 10^{-14} m
C) $6.19 \times 10^{-?}$ m
D) 6.19×10^{-19} m

Q22 Which of the following spectra is most typical of the output of an X-ray tube:

C) 

B) 

D) 

Q23 Which of the following techniques is the application of x-rays?
A) Magnetic resonance imaging
B) Ultrasonography
C) Computerized axial tomography
D) Position emission tomography

Q24 Which one of the following spectra is most typical of the output of x-rays tube?

[illegible] B) 
C) [illegible]
D) 

Q25 Which on of the following has the largest energy content?
A) γ - rays
B) x-rays
C) Infrared rays
D) Ultra violet radiations

Q26 If electrons of charge 'e' moving with velocity 'v' are accelerated through a pential differences 'V' and strike a metal target, then velocity of electron is:
[illegible]
C) $\sqrt{\frac{Ve}{2m}}$
D) $\sqrt{\frac{2Ve}{m}}$

2016

Q27 The continuous spectrum of X-ray is formed due to:
A) Characteristics of X-ray
B) Bremsstrahlung X-ray
C) Soft X-ray
D) Hard X-ray

Q28 The shadow of the bones in X-rays photographic film appears lighter than the surrounding flesh due to:
A) Bones reflect greater amount of X-rays
B) Bones absorb greater amount of X-rays
C) Bones absorb less amount of X-rays
D) Bones totally reflect X-rays

Q.29 The atom is excited to an energy level E_1 from its ground state energy level E_o. The wavelength of the radiations emitted is:

A) $\frac{(E_o - E_1)}{hc}$

B) $\frac{(E_1 - E_o)}{hc}$

C) $\frac{hc}{(E_1 - E_o)}$

D) $\frac{E_1}{hc} - \frac{E_o}{hc}$

Q.30 The target of X-ray tube is made of which metal?

A) Iron

B) Nickel

C) Brass

D) Tungsten

Q.31 The X-rays consist of:

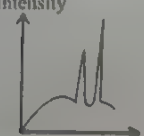
A) High energy proton

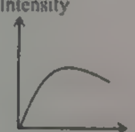
B) High energy electrons

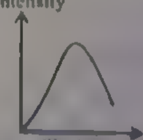
C) High energy γ-rays

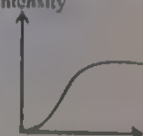
D) High energy photon

Q.32 Which of the following graph represents the output of an X-ray?

A) 

B) 

C) 

D) 

2017

Q.33 The momentum of wave of wavelength 1.32×10^{-9} is:

A) 5×10^{-26} Ns

B) 5×10^{-25} Ns

C) 5×10^{-43} Ns

D) 5×10^{-44} Ns

Q.34 Calculate the frequency of a photon having a momentum of 4.42×10^{-26} Ns:

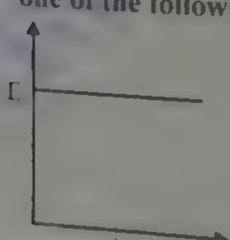
A) 2×10^{14} Hz

B) 2×10^{16} Hz

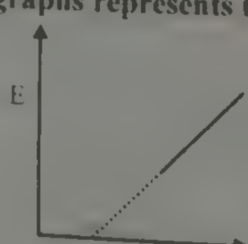
C) 5×10^{16} Hz

D) 2×10^{18} Hz

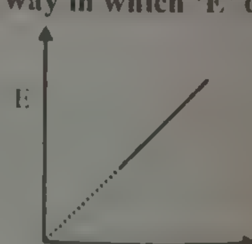
Q.35 The maximum kinetic energy 'E' of photoelectrons ejected by light of a certain wavelength from a metal is measured as function of the intensity 'I' of the light. Which one of the following graphs represents the way in which 'E' depends on 'I'?



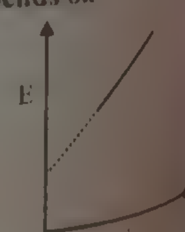
A)



B)



C)



D)

Q.36 **Ionization energy of hydrogen atom is equal to:**

A) 13.6 eV
B) 0.54 eV
C) 0.85 eV
D) 3.39 eV

2017

Q.37 **The hardest photon coming out from a Coolidge tube belongs to:**

A) Characteristic x-rays
B) Continuous x-rays
C) Both "A" & "B"
D) None of these

Q.38 **Which of the following X-rays has largest intensity?**

A) $K_{\alpha} X - ray$
B) $K_{\beta} X - ray$
C) $K_{\gamma} X - ray$
D) All have same intensity

Q.39 **The De-Broglie wavelength of particle of mass "m" moving with the kinetic energy "E" can be written as:**

A) $\sqrt{\dfrac{h}{2mE}}$
B) $\dfrac{h}{2mE}$
C) $\dfrac{h}{\sqrt{2mE}}$
D) $\dfrac{\sqrt{h}}{2mE}$

Q.40 **When light has exactly the same energy as the work function of a metal surface then:**

A) No photo electrons are produced
B) No photo electric effect is observed
C) No photo electric current is produced
D) All of the these

Q.41 **In above question if we use a light of photons having energy 2.4 eV then the stopping potential required will be:**

A) 2.4 V
B) 2.6 V
C) 2.5 V
D) 0 V

2018

Q.42 **A 5 watt LED bulb converts 80% of the power into light photons of wavelength 660 nm. What is the number of photons emitted from the bulb in one second?**

A) 5.8×10^{34}
B) 7.5×10^{18}
C) 6.6×10^{7}
D) 1.3×10^{19}

Q.43 **Light photons, each of energy 3.5×10^{-19}J falls on the cathode of a photocell. The current through the cell is reduced to zero by taking the cathode to a potential +0.25V relative to anode. The work function of the cathode is:**

A) 3.35×10^{-19} J
B) 3.5×10^{-19} J
C) 3.25×10^{-19} J
D) 3.1×10^{-19} J

Q.44 **In photo-emission from a metal, if light of λ is replaced by light of wavelength λ/4, the maximum kinetic energy of the photo-electrons:**

A) decreases by an amount equal to half of an incident photon of wavelength λ.
B) increase by an amount equal to four times energy of incident photon of
C) increase by an amount equal to the work function of the metal
D) decrease by an amount equal to the energy of an incident photon of wavelength

[illegible]

2019

Q.46 The value and units of the Plank constant 'h' can be expressed as:

A) [illegible]
B) [illegible]
C) [illegible] $\times 10^{-34}$ Js
D) 3.63×10^{-34} Js

Q.47 Minimum energy required to eject an electron from metal surface is called

A) Work function
B) Stopping potential
C) Threshold frequency
D) electromotive force

Q.48 Calculate the energy of a photon of frequency 3.0×10^{18} Hz. ($h = 6.63 \times 10^{-34}$ Js)

A) 19.89×10^{-18} J
B) 1.89×10^{-16} J
C) 11.89×10^{-16} J
D) 19.89×10^{-16} J

ANSWER KEY

1	A	11	C	21	C	31	D	41	A
2	A	12	D	22	A	32	A	42	D
3	A	13	B	23	C	33	B	43	D
4	B	14	C	24	B	34	B	44	B
5	C	15	B	25	A	35	A	45	C
6	D	16	D	26	D	36	A	46	C
7	B	17	A	27	B	37	B	47	A
8	C	18	C	28	B	38	A	48	D
9	D	19	D	29	C	39	C		
10	B	20	B	30	D	40	C		

EXPLANATORY NOTES

...ium coated oxidized silver emits electron for infrared light.
...effect removal of photons is observed at low energies.
... photoelectric equation is:

$hf = \phi + \frac{1}{2}mv$

Q.4 A crack allows greater amount of x-rays to pass which appears on photographic film as dark area.

Q.5 Definition of Threshold frequency.

Q.6 $V = 2.19 \times 10^{6}\ m/s$

Q.7 Wave length of x-rays is order of 10^{-10}m.

Q.8 Characteristics x-ray spectrum is due to the bombardment of target material by electrons.

Q.9 The energy of electron with which it hit the target material is $K.E = eV$

Q.10 X-rays produced Due ot the bombardment of electron which is emitted by cathode.

Q.11 K_α represent that the vacancy create in K shell and it filled by L shell electron the energy difference we can write. $hf_{K_\alpha} = E_l - E_k$

Q.12 X-rays high frequency rays so according to $Z \propto \sqrt{f}$. Target material have high atomic number.

Q.13 $\lambda_{min} = \frac{hc}{Ve} \Rightarrow \lambda_{min} \propto \frac{1}{V}$

Q.14 When Vacancy is filled by M – Shell then characteristics X – ray will be K_{beta}

Q.15 "CAT" stands for computerized axial tomography.

Q.16 $K.E = Ve$

$K.E \propto V$

$\frac{K.E_1}{K.E_2} = \frac{V_1}{V_2} = \frac{2}{3}$

Q.17 $K.E = Ve \Rightarrow \frac{1}{2}mv^2 = Ve$

$v = \sqrt{\frac{2Ve}{m}}$

Q.18 $K.E = Ve = 2 \times 10^3 \times 1.6 \times 10^{-19} = 3.2 \times 10^{-16}\ J$

Q.19 $E = hf$

$f = \frac{hc}{\lambda}$

[illegible]

Q.20 Energy of electron depends on frequency. [illegible]

Q.21 $\lambda_{min} = \frac{1240}{V}$ nm $= \frac{[illegible]}{20 \times 10^3}$ [illegible]

Q.22 [illegible] not a X-ray graph

Q.23 "CAT" is the application of x-rays

Q.24 "B" is correct graph

Q.25 Gamma rays has more energy.

Q.26 $V_e = \frac{1}{2} mv^2$

$v = \sqrt{\frac{2Ve}{m}}$

Q.27 The continuous spectrum of X-ray is formed due to **Bremsstrahlung X-ray**.

Q.28 Contain greater proportions of bones elements with high atomic number and so they absorb greater amount of X – rays.

Q.29 $\lambda = \frac{hc}{\Delta E} = \frac{hc}{E_1 - E_2}$

Q.30 Tungsten has high atomic number.

Q.31 Energy of X-rays high.

Q.32 "A" is correct graph.

Q.33 $\rho = \frac{h}{\lambda} = \frac{6.63 \times 10^{-34}}{1.32 \times 10^{-9}} = 5 \times 10^{-25}$ Ns

Q.34 $\lambda = \frac{h}{p} \Rightarrow \frac{c}{f} = \frac{h}{p}$ $\quad \because c = f\lambda$

$\Rightarrow f = \frac{pc}{h} = \frac{4.42 \times 10^{-26} \times 3 \times 10^8}{6.63 \times 10^{-34}} = 2 \times 10^{16}$ Hz

Q.35 Energy does not depends upon intensity of light

Q.36 $E = \frac{E_0}{n^2}$ $\quad \therefore \quad n = 1$

$E_0 = 13.6eV$

Q.37

Q.38 There are more number of electron to jump from excited state to K shell.

Q.39 $\lambda = \frac{h}{\sqrt{2mVe}}$

$Ve = K.E = E$

$\lambda = \frac{h}{\sqrt{2mE}}$

Q.40 $hf = hf_0 + K.E_{max}$

$K.E_{max} = 0$

$hf = hf_0$ and no photo – electric current is produced

Q.41

Q.42 $\frac{W}{hf} = \frac{nhf}{hf} \quad \because W = E = nhf$

$n = \frac{Pt}{hf} = \frac{Pt\lambda}{hc}$

$= \frac{80\%(5)\times1\times660\times10^{-9}}{6.63\times10^{-34}\times3\times10^{8}} = 1.3\times10^{19}$

Q.43 $K.E = Ve = 0.25\times1.6\times10^{-19} = 0.4\times10^{-19} J$

$\phi = E - K.E = 3.5\times10^{-19} - 0.4\times10^{-19} = 3.1\times10^{-19} J$

Q.44 $\lambda = \frac{h}{mv}$, $E' = \frac{hc}{\lambda/4} = 4\frac{hc}{\lambda} = 4E$

Q.45 $\lambda = \frac{h}{mv} = \frac{6.63\times10^{-34}}{9.1\times10^{-31}\times1\times10^{7}} = 7.3\times10^{-11} m$

Q.46 Value and units of plank's constant is $h = 6.63\times10^{-34}$ Js.

Q.47 Definition of work function.

Q.48 $E = hf = 6.63 \times 10^{-34} \times 3 \times 10^{18} = 1.989 \times 10^{-15} J = 19.89 \times 10^{-16} J$

NUCLEAR PHYSICS

TOPIC-16 PRACTICE EXERCISE

TOPIC-WISE MCQ's

NUCLEUS, NUCLEON NUMBER AND CHARGE NUMBER

Q.1 **What are the number of neutrons, protons and electrons in a neutral atom of $^{235}_{92}U$?**

	Number of neutrons	Number of protons	Number of electrons
A)	92	143	143
B)	92	235	235
C)	143	92	92
D)	235	92	92

Q.2 **Which two nuclei contain the same number of neutrons?**

A) $^{12}_{6}C$ and $^{14}_{6}C$
C) $^{23}_{11}Na$ and $^{24}_{12}Mg$
B) $^{16}_{7}N$ and $^{15}_{8}O$
D) $^{32}_{14}Si$ and $^{32}_{15}P$

Q.3 **Nucleus of an atom whose atomic mass is 24 consists of**

A) 11 electrons. 11 protons and 13 neutrons
C) 11 protons and 13 neutrons
B) 11 electrons. 13 protons and 11 neutrons
D) 11 protons and 13 electrons

Q.4 **As compared 12C atom, 14C atom has**

A) Two extra protons and two extra electrons
B) Two extra protons but no extra electrons
C) Two extra neutrons and no extra electrons
D) Two extra neutrons and two extra electrons

RADIOACTIVITY AND EMISSION OF RADIATION

NUCLEAR TRANSMUTATION AND CONSERVATION OF MASS, ENERGY. MOMENTUM AND CHARGE DURING NUCLEAR CHANGES

Q.5 **During a negative β-decay**

A) An atomic electron is ejected
B) A neutron in the nucleus decays emitting an electron
C) An electron which already present with in the nucleaus is ejected
D) A part of binding energy of nuclei is converted into electron

Q.6 **The most penetrating radiations out of the following is that of**

A) γ-rays
B) β-rays
C) α-particles
D) X-rays

Q.7 **In a given reaction** $^{A}_{Z}X \longrightarrow {}^{A}_{Z+1}Y \longrightarrow {}^{A-4}_{Z-1}B \longrightarrow {}^{A-4}_{Z-1}B$

Radioactive radiations are emitted in the sequence

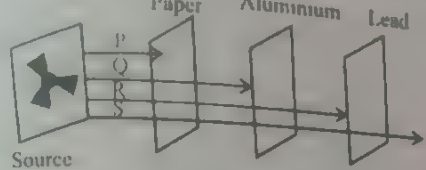
A) γ,β,γ
B) γ,α,β
C) β,α,γ
D) α,γ,β

Q.8 **When boron $^{10}_{5}B$ is bombarded by neutrons, α-particles are emitted. The resultant nucleus has the mass number**

A) 11
B) 7
C) 6
D) 15

Q.9 In which radioactive disintegration neutron dissociates into proton and electron?
A) α–emission
B) γ–emission
C) β emission
D) None of these

Q.10 Which of the arrangement about the particle is in accordance with the diagram?



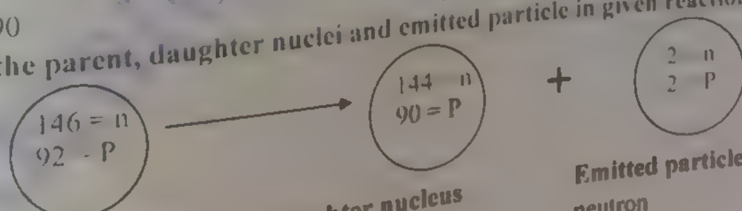
	P	Q	R	S
A)	α	β	γ	n
B)	α	β	n	γ
C)	α	β	n	γ
D)	γ	n	β	α

Q.11 When a radioactive nucleus emits a beta particle, the proton neutron ratio:
A) Decreases
B) Remains the same
C) Increases
D) None of the above

Q.12 Beta particles have penetration of about:
A) 100 times more than that of the gamma particles
B) 100 times less than that of an alpha ray
C) 100 times more than that of an alpha ray
D) 10 times more than that of an alpha particle

Q.13 $_{92}U^{238}$ nucleus emits two α-particles and two β-particles and transforms into a thorium nucleus. Which of the following is the mass number and atomic number of the thorium nucleus so produced?
A) 230, 90
B) 234, 90
C) 230, 88
D) 234, 88

Q.14 Specify the parent, daughter nuclei and emitted particle in given reaction



	Parent nucleus	Daughter nucleus	Emitted particle
A)	Thorium	Uraniumy	neutron
B)	Thorium	Uranium	Alpha
C)	Uranium	Thorium	neutron
D)	Uranium	Thorium	Alpha

Q.15 Which statement concerning α-particles, is correct?
A) An α-particle has charge +4e
B) An α-particle is a helium atom
C) When α particle travel through air, they cause ionization
D) When α-particle travel through a sheet of gold foil, they make the gold radioactive

Q.16 The following represents a sequence of radioactive decays involving two α-particles and one β-particles. $^{217}_{85}At \xrightarrow{\alpha} V \xrightarrow{\alpha} W \xrightarrow{\beta} X$

What is the nuclide X?

A) $^{213}_{84}At$

B) $^{214}_{77}Ir$

C) $^{209}_{82}Pb$

D) $^{217}_{81}Tl$

Q.17 The decay of a nucleus of neptunium is accompanied by the emission of a β-particle and γ radiation. What effect (if any) does this decay have on the proton number and the nucleon number of the nucleus?

	proton number	nucleon number
A)	increases	decreases
B)	decreases	increases
C)	unchanged	decreases
D)	increases	unchanged

Q.18 Radon-220 is radioactive and decays to Polonium-216 with the emission of an α-particle. The equation for the radioactive decay is shown. $^{220}_{86}Rn \rightarrow ^{216}_{84}Po + ^{4}_{2}He$ How many neutrons are in the radon and polonium nuclei?

	Rn	Po
A)	86	84
B)	134	132
C)	220	212
D)	220	216

Q.19 Rodon $^{222}_{86}Rn$ decays by α-and β-emission to bismuth $^{214}_{83}Bi$ For the decay of each nucleus of radon. How many α–and β– particles are emitted?

	α–particles	β–particles
A)	1	1
B)	2	1
C)	1	2
D)	2	2

Q.20 A radioactive nucleus undergoes a series of decay according to the scheme $A \xrightarrow{\alpha} A_1 \xrightarrow{\beta} A_2 \xrightarrow{\alpha} A_3 \xrightarrow{\gamma} A_4$. If the mass number and atomic number of A are 180 and 72 respectively, then what are these number for A4.

A) 172 and 69

B) 174 and 70

C) 176 and 69

D) 176 and 70

ACTIVITY, DECAY CONSTANT AND RELATION ACTIVITY = Nλ

Q.21 The decay constant λ of a radioactive sample

A) Decrease as the age of atoms increase

B) Is independent of the age

C) Increase as the age of atoms increase

D) Depends on the nature of activity

Q.22 A radioactive decay rate of radioactive elements is found to be 10^3 disintegration per second at a certain time. If the half-life of the element is 1 second, the decay rate after one second ______ and after 3 second is ______

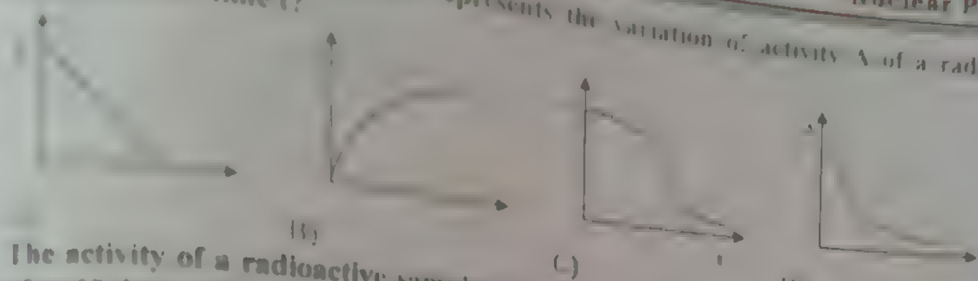
A) 500, 125

B) 10^3, 10^3

C) 125, 500

D) 100, 10

Which of the following graph represents the variation of activity A of a radioactive substance with time t?



Q.24 The activity of a radioactive sample is 1.6 curie and its half-life is 2.5 days. Its activity after 10 days will be

A) 0.8 curie
B) 0.4 curie
C) 0.1 curie
D) 0.16 curie

HALF LIFE OF RADIOACTIVE SUBSTANCE AND RELATION $\lambda = \frac{0.693}{t_{\frac{1}{2}}}$

Q.25 If the radioactive decay constant of radium is 1.07×10^{-4} per year, then its half-life period is approximately equal to

A) 8,900 years
B) 7,000 years
C) 6,476 years
D) 2,520 years

Q.26 A radioactive element emits 200 particles per second. After three hours 25 particles per second are emitted. The half-life period of element will be

A) 50 minutes
B) 60 minutes
C) 70 minutes
D) 80 minutes

Q.27 A radioactive substance has a half-life of 60 minutes. After 3 hours, the fraction of atom that have decayed would be

A) 12.5%
B) 87.5%
C) 8.5%
D) 25.1%

Q.28 Half life of radium is 1600 years. Which of the following is the fraction of a sample of radium that would remain undecayed after 6400 years?

A) $\frac{1}{2}$
B) $\frac{1}{8}$
C) $\frac{1}{4}$
D) $\frac{1}{16}$

Q.29 The half-life of Bi^{210} is 5 days. If we start with 50000 atoms of this isotope then which of the following will be the number of atoms left over after ten days?

A) 5000
B) 25000
C) 12500
D) 25000

Q.30 Which of the following is the percentage of the original quantity of a radioactive material left after five half lives approximately?

A) 3%
B) 1%
C) 5%
D) 5%

Q.31 Half-life of radioactive element depends upon

A) Amount of element present
B) Pressure
C) Temperature
D) None

UHS Topic 10

Q.32 Relation for half life of any radioactive element is

A) $T_{\frac{1}{2}} = \lambda \ln 2$

B) $T_{\frac{1}{2}} = \frac{\ln 2}{\lambda}$

C) $\lambda = T_{\frac{1}{2}} \ln 2$

D) $T_{\frac{1}{2}} = \frac{\lambda}{\ln 2}$

Q.33 The half-life period of radium is 1600 years. Its average life time will be

A) 3200 years

B) 4800 years

C) 2319 years

D) 4217 years

MASS DEFECT, BINDING ENERGY AND RELATION $E = mc^2$

Q.34 For atomic nucleus, the binding energy per nucleon__________with increase in mass number

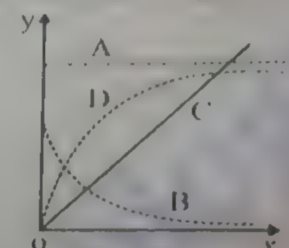
A) Increases continuously

B) Remains constant

C) Decrease continuously

D) First increases and then decreases

Q.35 In Fig. X represents time and Y represent activity of a radioactive sample. Then the activity of sample, varies with time according to the curve



A) A

B) B

C) C

D) D

Q.36 If the binding energy of the deuterium is 2.23 MeV. The mass defect given in a.m.u is

A) –0.0024

B) –0.0012

C) 0.0012

D) 0.0024

Q.37 The masses of neutron and proton are 1.0087 a.m.u. and 1.0073 a.m.u. respectively. If the neutrons and protons combine to form a helium nucleus (alpha particles) of mass 4.0015 a.m.u. The binding energy of the helium nucleus will be (1 a.m.u.= 931MeV)

A) 28.4 MeV

B) 20.8 MeV

C) 27.3 MeV

D) 14.2 MeV

Q.38 The mass defect for the nucleus of helium is 0.0303 a.m.u. What is the binding energy per nucleon for helium in MeV

A) 28

B) 7

C) 4

D) 1

Q.39 If M is the atomic mass and A is the mass number, packing fraction is given by

A) [illegible]

B) $\frac{A-M}{A}$

C) $\frac{\Delta M}{M-A}$

D) $\frac{M-A}{M}$

Q.40 In a fission process, nucleus A divides into two nuclei B and C, their binding energies being E_a, E_b and E_c respectively. Then

A) $E_b - E_c = E_a$

B) $E_b + E_c > E_a$

C) $E_b + E_c < E_a$

D) $E_b, E_c = E_a$

NUCLEAR FISSION AND FUSION

Q.41 Complete the equation for following fission process: $_{92}U^{235} + _0n^1 \longrightarrow _{38}Sr^{90} + \ldots\ldots$

A) $_{54}Xe^{143} + 3_0n^1$

B) $_{54}Xe^{142} + 3_0n^1$

C) $_{54}Xe^{145}$

D) $_{57}Xe^{142}$

Q.42 Which row is correct for fission and for fusion?

	Fission of a nucleus	Fusion
A)	Produces larger nuclei	Is the energy source of a star
B)	Produces larger nuclei	Is used to release energy in a power station
C)	Produces smaller nuclei	Is the energy source of a star
D)	Produces smaller nuclei	Is used to release energy in a power station

Q.43 The example of nuclear fusion is

A) formation of barium and krypton from uranium

B) formation of helium from hydrogen

C) formation of plutonium –235 from uranium –235

D) formation of water from hydrogen and oxygen

Q.44 Nuclear fission is the phenomenon of

A) Heavy nucleus splitting

B) Heavy nucleus combining

C) Light nucleus splitting

D) Light nucleus combining

Q.45 An atom bomb is a

A) Controlled fission reaction

B) Controlled fusion reaction

C) Uncontrolled fission reaction

D) Uncontrolled fusion reaction

Q.46 Nuclear fusion is the phenomenon of

A) Heavy nucleus splitting

B) Heavy nuclei combining

C) Light nucleus splitting

D) Light nuclei combining

Q.47 The fusion reaction takes place under

A) High Temperature and Low Pressure

B) Low Temperature and High Pressure

C) High Temperature and High Pressure

D) Low Temperature and Low Pressure

HADRONS, LEPTONS AND QUARKS

Q.48 Top and bottom quark carries charge

	Top	Bottom
A)	–2/3 e	+1/3 e
B)	+2/3 e	–1/3 e
C)	+1/3 e	1/3 e
D)	–2/3 e	2/3 e

Q.49 The particles that experience the strong nuclear force are

A) Quarks

B) Hadrons

C) Leptons

D) Positrons

Q.50 Three quarks make up a

A) Lepton

B) Meson

C) Baryon

D) Quark

ANSWER KEY

1	C	11	C	21	B	31	D	41	A
2	C	12	C	22	A	32	B	42	C
3	C	13	A	23	D	33	C	43	B
4	C	14	D	24	C	34	D	44	A
5	B	15	C	25	C	35	B	45	C
6	A	16	C	26	B	36	D	46	D
7	C	17	D	27	B	37	A	47	C
8	B	18	B	28	D	38	B	48	B
9	C	19	B	29	C	39	D	49	B
10	A	20	A	30	A	40	B	50	C

EXPLANATORY NOTES

proton ... Number of electrons ... 92

Number of neutrons = N = A − Z = 143

Number of neutrons in Na^{23}_{11} = 23 − 11 = 12

Number of neutrons in Mg^{24}_{12} = 24 − 12 = 12

Q.3 Nucleus of an atom whose atomic mass is 24 consist of

A = P + N

24 = 11 + 13

So number of protons = 11

Number of neutrons = 13

Q.4 For $_6C^{12}$, p = 6, e = 6, n = 6 For $_6C^{14}$, p = 6, e = 6, n = 8

Q.5 β particle is emitted when neutron breaks.

Q.6 γ rays are more penetrating than that of α, β and other electromagnetic radiations.

Q.7 X ⟶ Y ⟶ B ⟶ B

- When β is emitted then charge will increase.
- When α is emitted then mass will reduce by 4 and charge will reduce by 2.

Q.8 $B + _0n \rightarrow _3X + ^4_2He$ Resultant nucleus has mass number "7".

Q.9 In β emission $n \rightarrow \beta + H$

Q.10 Order of penetration power is $\alpha < \beta < \gamma < n$

Q.11 β-particle emits when a neutron break and proton is produced as follow.

$n \rightarrow p + \beta + \nu$ p + 1 , p ; n − 1 , n

So, number of protons increase and number of neutrons decrease and proton-neutron ratio

... 100 times more than α-particles

Q.12 ... particle and emitted radiation is He

Q.13 ... He ... uranium ... β

Q.14 Here parent n ... when they pass through ...

So, correct option ...

Q.15

Q.16 [illegible]

Q.17 By the emission of a β particle and [illegible] radiation from nucleus of neptunium then [illegible] number increases by 1 but nucleon number" remains same

Q.18 Number of neutrons in radon = 220-86=134

Number of neutrons in polonium = 216-84=132

Q.19 ${}^{222}_{86}Rn \xrightarrow{\alpha} {}^{218}_{84}X \xrightarrow{\alpha} {}^{214}_{82}Y \xrightarrow{\beta} {}^{211}_{83}Bi$

No of α-particles = 2

No of β-particles = 1

Q.20 $X \longrightarrow A^{176} \xrightarrow{\beta} {}_{71}A^{176} \xrightarrow{\alpha} {}_{69}A^{172}_{3} \xrightarrow{\gamma} {}_{69}A^{172}_{1}$

Q.21 λ is decay constant that remain constant and does not depend upon age.

Q.22 After 1 sec. 1 half-life will pass so, remaining activity $= \frac{10^3}{2^1} = 500$

- After 3 sec, 3 half-lives will pass so, Remaining activity $= \frac{10^3}{2^3} = \frac{1000}{8} = 125$

Q.23 It is a decay curve which is "D".

Q.24 Number of half lives $n = \frac{10}{2.5} = 4 \Rightarrow \frac{A}{A_o} = \frac{N}{N_o} = \left(\frac{1}{2}\right)^n \Rightarrow A = 1.6 \times \left(\frac{1}{2}\right)^4 = 0.1$ curie

Q.25 $\text{Half-life}\left(T_{\frac{1}{2}}\right) = \frac{0.693}{\lambda} = \frac{0.693}{1.07 \times 10^{-4}} = 6476$ years

Q.26 $R = \frac{dN}{dt} \propto N \Rightarrow \frac{R_2}{R_1} = \frac{N_2}{N_1}$ But $\frac{N_2}{N_1} = \left(\frac{1}{2}\right)^{t/T_{\frac{1}{2}}} \Rightarrow \frac{25}{200} = \frac{1}{8} = \left(\frac{1}{2}\right)^3 \Rightarrow \frac{t}{t_{\frac{1}{2}}} = 3$

$\therefore t_{\frac{1}{2}} = \frac{t}{3} = \frac{3}{3} = 1\,\text{hour} = 60\,\text{minutes}$

Q.27 $N = N_o\left(\frac{1}{2}\right)^{t/T_{\frac{1}{2}}}$. Hence fraction of atoms decayed $= 1 - \frac{N}{N_o} = 1 - \left(\frac{1}{2}\right)^{t/T} = 1 - \left(\frac{1}{2}\right)$ [illegible]

In percentage it is $\frac{7}{8} \times 100 = 87.5$

Q.28 $N = N_o\left(\frac{1}{2}\right)^n$ Given information $n = \frac{6400}{1600} = 4$

Remaining amount $= \frac{1}{2^n} = \frac{1}{16}$

Q.29 10 days has 2 half lives

So, remaining amount $= N_o\left[\frac{1}{2}\right]^n$

Remaining amount $= \frac{50000}{2^2} = \frac{50000}{4} = 12500$

Q.30 After 5 half-lives remaining amount $= \left(\frac{1}{2}\right)^5 = \frac{1}{32}$

Percentage of remaining amount $= \frac{1}{32} \times 100 \approx 3\%$

Q.31 Half-life is a natural process that does not depend upon amount of element present, pressure and temperature.

Q.32 $T_{1/2} = \frac{\ln 2}{\lambda}$

Q.33 Average life $\frac{1}{\lambda} = \frac{1600}{0.693} = 2308 \approx 2319$ years

Behavior of λ with time depends on the nature of the activity

Q.34 For atomic nucleus, the $\frac{\text{B.E}}{\text{nucleon}}$ first increases and then decrease with increase in mass number.

Q.35 Activity $= \frac{dN}{dt} = \lambda N = \lambda N_0 e^{-\lambda t}$ i.e., graph between activity and t, be exponential having negative slope.

Q.36 Mass defect $\Delta m = \frac{2.23}{931} = 0.0024$

Q.37 $BE = \Delta mc^2 = \left[2(1.0087 + 1.0073) - 4.0015\right] = 28.4$ MeV

Q.38 $\frac{\text{Binding energy}}{\text{Nucleon}} = \frac{0.0303 \times 931}{4} \approx 7$

Q.39 Packing frction $= \frac{M - A}{A}$

Q.40 $E_b + E_c > E_a$

Q.41 ${}^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{90}_{38}Sr + {}^{143}_{54}Xe + 3{}^{1}_{0}n$

Q.42 In fission of a nucleus, a heavy nucleus breaks into smaller nuclei along neutrons and large amount of energy, but fusion process is the energy source of star.

Q.43 Formation of helium from hydrogen is the example of nuclear fusion.

Q.44 Nuclear fission is the phenomenon of splitting of a heavy nucleus into lighter nuclei.

Q.45 A chain reaction is a series of fission reactions. In an atom bomb, an uncontrolled chain reaction proceeds while principle of nuclear reactor is controlled chain reaction.

Q.46 Nuclear fusion is the process in which two lighter nuclei fuse together to form a single heavy nucleus.

Q.47 The fusion reaction takes place under the conditions of extremely high temperature ($\approx 10^7$ K) and pressure. This is necessary so that the protons have high enough Kinetic Energy to overcome their mutual repulsion.

Q.48 Top and bottom quarks carry charge $\frac{2}{3}e$ and $-\frac{1}{3}e$ respectively

Q.49 Hadrons experience strong nuclear force

Q.50 Baryon is formed when 3 quarks are combined

PAST PAPER MCQ's (2008-2019)

2008

Q.1 **Which one is most stable element on the basis of binding energy?**

A) Sn
B) Ba
C) Kr
D) Fe

Q.2 ________ **are the particles that experience strong nuclear force.**

A) Electrons
B) Muons
C) Neutrinos
D) Neutrons

Q.3 **The neutron is assumed to be made of:**

A) One up quark and two down quarks
B) Two up quarks and two down quarks
C) Two up quarks and one down quark
D) One up quark and one down quark

Q.4 **A certain radioactive mass decays from 64 gm to 2 gm in 20 days. What is its half-life?**

A) 5 days
B) 4 days
C) 10 days
D) 6 days

Q.5 **When a helium atom loses an electron, it becomes:**

A) An alpha particle
B) Proton
C) A positive helium ion
D) A negative helium ion

Q.6 **Beta ray emitted by a radioactive substance is:**

A) An electron which was existing outside the nucleus.
B) An electron which was existing inside the nucleus.
C) An electron emitted by the nucleus as a result of the decay of neutron inside the nucleus
D) A pulse of electromagnetic wave.

2009

Q.7 **The emission of γ-radiations from the nucleus is generally represented by the equation**

A) ${_ZX^A} \rightarrow {_ZX^A} + \gamma$ – radiations
B) ${_ZX^{\dot{A}}} \rightarrow {_{ZA}X^A} + \gamma$ – radiations
C) ${_ZX^A} \rightarrow {_ZX^A} + \beta$ – particles
D) ${_ZX^{\dot{A}}} \rightarrow {_ZX^A} + \gamma$ – radiations

2010

Q.8 **In the half-life of an element, the equation for the number of decaying atoms is given**

A) $\Delta N = N\Delta t$
B) $\Delta N = KN\Delta t$
C) $\Delta N \propto -n\Delta t$
D) $\Delta N = -\Delta N\Delta t$

Q.9 **Decay constant 'λ' is given a:**

A) $-\dfrac{\Delta N / N}{\Delta t}$
B) $-\dfrac{\Delta N}{\Delta t}$
C) $-\dfrac{N}{\Delta t}$
D) $\dfrac{\Delta N / N}{\Delta t}$

Ionizing capability of gamma rays is:

A) Equal to alpha and beta particle

B) Less than alpha but greater than beta particles

C) Less than both alpha and beta particles

D) Less than beta but greater than alpha particles

Q.11 **Half-life of a radioactive element is:**

A) Inversely proportional to square of decay constant

B) Directly proportional to square of decay constant

C) Directly proportional to decay constant

D) Inversely proportional to decay constant

Q.12 **The transformation of a neutron into proton in the nucleus gives rise to emission of:**

A) Beta particles

B) Alpha particles

C) Gamma particles

D) X-rays

Q.13 The ratio of the rate of decay of a parent atom to the number of radioactive nuclei present at that time is equal to:

A) Half-life of radioactive element

B) Mean life

C) Decay constant of radioactive element

D) Activity of radioactive element

Q.14 Which one of the following particles is emitted as a result of nuclear reaction?

A) Beta

B) Alpha

C) Gamma rays

D) One alpha and one beta

2012

Q.15 **What is the charge on alpha particles emitted during the phenomenon of radioactivity?**

A) +e

B) -e

C) -2e

D) +2e

Q.16 **A radioactive nuclide decays by emitting an α-particle and a γ-ray photon, the change in the nucleon number will be:**

A) [illegible]

B) [illegible]

C) -2

D) -3

Q.17 **A half-life of sodium-24 is ___ which is used to estimate the volume of blood in a patient:**

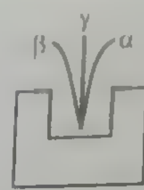
A) 6 hours

B) 15 hours

C) 8 hours

D) [illegible] days

Q.18 In a radioactive phenomenon, observation shown in figure where α deviates lesser than β in same electric or magnetic field (not shown in the figure). What is the reason of less deviation of α?



A) α is a lighter particle
C) α is heavier particle
B) α is very fasting moving particle
D) None of these

Q.19 Which of the following effect is observed due to emission of β during the phenomenon of radioactivity?
A) A increases by 1 and Z remains same
C) Z decreases by 1 and A remains same
B) Z increases by 1 and A remains same
D) A decreases by 1 and Z remains same

2013

Q.20 Isotopes are those nuclei of an element that have:
A) Same mass number but different atomic number
B) Same mass number as well as atomic number
C) Different mass number as well as atomic number
D) Same atomic number but different mass number

Q.21 Emission of alpha decay from a radioactive substance cause:
A) Decrease in 'Z' by 4 and decrease in 'A' by
B) Decreases in 'A' by 1 and 'Z' remains same
C) Decrease in 'Z' by 1 and 'A" remains same
D) Decrease in 'A' by 4 and decrease in 'Z' by 2

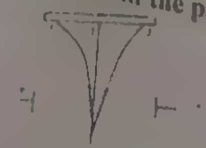
Q.22 Which one of the following emissions takes place in a nuclear reaction?
$_{90}Th^{234} \rightarrow {}_{91}Pa^{234} +$ ----------
A) Alpha
C) Beta
B) Gamma
D) Photons

Q.23 Among the three types of radioactive radiation, which have strongest penetration power?
A) Alpha
C) Beta
B) Gamma
D) α, β and γ have same penetration

Q.24 Emission of radiation from radioactive substance is
A) Dependent on both temperature and pressure
B) Independent of temperature but dependent on pressure
C) Independent of both temperature and pressure
D) Independent of pressure but dependent on temperature

2014

Q.25 Three points of radioactive radiation are observed as shown in the figure presence of electric field, which type of radiation is shown in the path '1'?



A) Alpha
B) Gamma
C) Beta
D) Cathode ray

Q.26 A beta particle is a fast-moving electron, During a β decay how the atomic number and mass number of a nucleus change?

	Atomic number	Mass number
A)	Remains the same	Increases by one
B)	Increases by one	Decreases by two
C)	Increases by one	Remains the same
D)	Decreases by two	Decreases by four

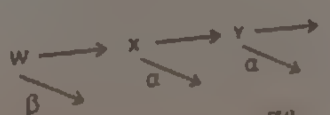
Q.27 A uranium isotope $^{234}_{92}U$ undergoes one α-decay and one $^{0}_{-1}\beta$-decay. What is the atomic number of the final product?

A) 90
B) 91
C) 89
D) 88

Q.28 A naturally occurring radioactive element decays two alpha particles. Which one of the following represents the status of daughter element with respect to mass number A and charge number Z?

A) Z decreases by 4 and A decreases by 2
B) Z decreases by 2 and A decreases by 4
C) Z decreases by 4 and A decreases by 8
D) Z decreases by 8 and A decreases by 4

Q.29 A radioactive isotope W decay to x which decay to Y and Y decays to Z as represented by the figure below.



What is the change in the atomic number from W to Z?

A) Increases by 3
B) Decreases by 3
C) Increases by 5
D) Decreases by 5

2015

Q.30 In the reaction $^{234}_{90}Th \rightarrow ^{234}_{91}Pa + ^{0}_{-1}e$ the electron $^{0}_{-1}e$ emits from the

A) 1st orbit
B) 2nd orbit
C) Nucleus
D) Valence shell

Q.31 According to the equation [illegible] particles, what are the atomic and mass numbers of Y?

A) Z-6, A-12

B) [illegible]

C) Z+1, A

D) Z+3, A

Q.32 **A certain radioactive nuclide of mass number 'x' decay by β–emission and α-emission to a second nuclide of mass number 't', which of the following correctly relates 'x' and 't'?**

A) x = t - 4

B) x = t + 4

C) x + 3 = t

D) x – 1 = t

Q.33 **During the decay of radioactive isotopes ^{212}X to a stable isotopes , six α-particles and four β particles are emitted, what is the atomic number 'Z' and mass number 'A' of the stable isotopes:**

A) Z = 70, A = 220

B) Z = 78, A = 212

C) Z = 82, A = 212

D) Z = 82, A = 208

2016

Q.34 **Wavelength of γ-rays is:**

A) Equal to the X-rays

B) Longer than X-rays

C) Shorter than X-rays

D) Broader than X-rays

Q.35 **Thorium is transformed after the emission of β-particle into:**

A) Bismuth

B) Protactinium

C) Polonium

D) Palladium

Q.36 **Emission of γ-rays from radioactive element result into:**

A) Increase of charge number 1

B) Decrease of mass number by 1

C) No change in the charge number

D) Decrease charge number by 1

Q.37 **The relation between decay constant 'λ' and half-life '$T_{1/2}$' of radioactive substance?**

A) [illegible]

B) $\lambda = 0.693\ T_{1/2}$

C) [illegible]

D) $\lambda = \frac{0.693}{T_{1/2}}$

[illegible]

Q.38 Complete the radioactive equation [illegible] $\longrightarrow$ [illegible] Y + [illegible]

A) [illegible]

B) [illegible] Z

C) [illegible] Z

D) [illegible] Z

Q.39 The quantity of uranium is 400g. After 3rd half-life, how much uranium will be left?

A) 50g

B) 25g

C) 100g

D) 200g

Q.40 The mass of one Radium atom is decreased by 8.6×10^{-30} kg. This mass defect is equivalent to the energy is:

A) 4.84 MeV

B) 4.48 Mev

C) 3×10^2 MeV

D) 4.84 eV

Retake 2017

Q.41 The half-life of radium is about 1600 years. If 100 g radium existing now, 25 g will remain un-decayed after:

A) 4800 years

B) 6400 years

C) 2400 years

D) 3200 years

Q.42 Which of the following has maximum ionizing power?

A) α

B) β

C) γ

D) Neutron

Q.43 A radioactive nucleus X undergoes a series of decay according to the same:

$$X \xrightarrow{\alpha} X_1 \xrightarrow{\beta} X_2 \xrightarrow{\alpha} X_3 \xrightarrow{\gamma} X_4$$

If the mass number and atomic number of X are 180 and 72 respectively, the corresponding number of x4 are:

A) 176, 69

B) 176, 7

C) 172, 69

D) 172, 71

[illegible]

Q.44 What name of the energy which is released when an atom is formed from its constituent particles?

A) Atomic Energy

B) Radioactive Energy

C) Nuclear Energy

D) Binding Energy

[illegible]

Q.45 Calculate the activity (decaying atom per unit time) of radioactive strontium-90 having 6.7×10^{21} atoms at t=0 decay constant of strontium-90 is $8.3\times10^{-10}\ s^{-1}$

A) 8.01×10^{10}Bq
B) $5.6\times10^{11}s^{-1}$
C) 5.6×10^{12}Bq
D) 12×10^{11}Bq

Q.46 Calculate the half-life of bismuth-214 which has a decay constant of $4.3\times10^{3}\ s^{-1}$

A) 2.9×10^{-4} s
B) 1.6×10^{-4} s
C) 3.9×10^{3} s
D) 2.9×10^{3} s

2019

Q.47 In relation $\lambda\ T_{1/2} = 0.693$, which quantity is represented by λ.

A) half-life
B) wavelength
C) activity
D) decay constant

Q.48 Heavy nucleus of atoms go through fission so that they can:

A) absorb high amount of energy
B) absorb low amount of energy
C) increase their binding energy per nucleon
D) reduce their binding energy per nucleon

Q.49 What is the quark compositions of a proton?

A) Two up quarks and one down quark
B) Two up quarks and one strange quark
C) one up quark and two strange quarks
D) two down quarks and one up quark

ANSWER KEY

1	D	11	D	21	D	31	A	41	D
2	D	12	A	22	C	32	B	42	A
3	A	13	C	23	B	33	D	43	C
4	B	14	A	24	C	34	C	44	D
5	C	15	D	25	B	35	B	45	C
6	B	16	A	26	C	36	C	46	B
7	D	17	B	27	B	37	D	47	D
8	A	18	C	28	C	38	D	48	C
9	A	19	B	29	B	39	A	49	A
10	C	20	D	30	C	40	A		

EXPLANATORY NOTES

Q.1 ...on is most stable element having $\frac{BE}{Nucleon} = 8.8MeV$

Q.2 Neutrons are the particles that experience strong nuclear force.

Q.3 $N = U + d + d$

$\frac{2}{3} - \frac{1}{3} - \frac{1}{3} = 0$

Q.4 $m = 64g$

In

$1T_{1/2} = 32g$

$2T_{1/2} = 16g$

$3T_{1/2} = 8g$

$4T_{1/2} = 4g$

$5T_{1/2} = 2g$

$n = 5$

$T_{1/2} = \frac{t}{n} = \frac{20}{5} = 4\text{days}.$

Q.5 When a helium atom loses an electron, it gets positive charge and becomes a positive helium ion.

Q.6 Beta ray emitted by a radioactive substance is an electron which was existing inside the nucleus $_{Z}X^{A} \longrightarrow {}_{Z+1}Y^{A} + \beta^{o}_{-1} + \bar{v}$

Emission of $\beta-$ particles is a nuclear phenomenon.

Q.7 $_{Z}X^{A} \longrightarrow {}_{Z}X^{A} + \gamma -$ radiation

Q.8 $\Delta N = -N\Delta t$

Q.9 $\lambda = -\frac{\Delta N / N}{\Delta t}$

Q.10 $\gamma - \text{rays}_{I.E} < \beta - \text{rays}_{I.E} < \gamma - \text{particles}_{I.E}$

Q.11 $T_{\frac{1}{2}} = \frac{0.693}{\lambda} \Rightarrow T_{\frac{1}{2}} \propto \frac{1}{\lambda}$

Q.12 $_{0}n^{1} \longrightarrow {}_{1}H^{1} + \beta^{0}_{-1} + \bar{v}$

Q.13 $\frac{\Delta N}{N}$

Q.14 $R^{226} \longrightarrow R^{222} + He^{4}_{2}$

Q.15 Alpha particle is also known as Helium nuclide, and Helium nuclide have charge 2e.

Q.16 [illegible]

Q.17 Half-life of sodium-24 is 15 hours.

Q.18 α particle has more momentum So, it will less deviate.

Q.19 $X_Z^A \xrightarrow{\beta^0_{-1}} Y_{Z+1}^A$

Q.20 Definition

Q.21 $X_Z^A \xrightarrow{\alpha} Y_{Z-2}^{A-4}$

Q.22 ${}_{90}Th^{234} \longrightarrow {}_{91}Pa^{234} + \beta^0_{-1}$

Q.23 $\alpha < \beta < \gamma$

Q.24 Emission of radiation from radioactive substance is a natural phenomenon. So, it is independent of both temperature and pressure.

Q.25 The electric field do not disturb γ-radiation because they have no charge.

Q.26 During beta deca, Atomic number increases by 1 and mass number remains same.

Q.27 ${}_{92}U^{234} \xrightarrow{\alpha} {}_{90}Y^{230} \xrightarrow{\beta} {}_{91}Y^{230}$ So, z=91

Q.28 ${}_{Z}X^{A} \xrightarrow{2\alpha} {}_{Z-4}Y^{A-8}$

Q.29

$$\begin{tikzcd} W \arrow[r] \arrow[dr] & {}_{+1}X \arrow[r] \arrow[dr] & {}_{-1}Y \arrow[r] \arrow[dr] & {}_{-3}Z \\ & \beta & \alpha & \alpha \end{tikzcd}$$

Q.30 $\beta-$particles emit from nucleus.

Q.31 $X_Z^A \xrightarrow{3\alpha} Y_{Z-6}^{A-12}$

Q.32 $X_Z^A \longrightarrow Y_{Z+1}^{X} \xrightarrow{\alpha} Y_{Z-1}^{X-4=t}$

$X-4=t$

$X=t+4$

Q.33 $X_{90}^{232} \xrightarrow{6\alpha} X_{78}^{208} \xrightarrow{4\beta} X_{82}^{208}$

Q.34 $E=\frac{hc}{\lambda} \Rightarrow E \propto \frac{1}{\lambda} \Rightarrow \lambda_{\gamma-rays} < \lambda_{x-rays}$

Q.35 ${}_{90}Th^{234} \longrightarrow {}_{91}Pa^{234} + \beta^0_{-1}$

Q.36 $X_z^{a^*} \longrightarrow X_z^{a} + \gamma - rays$

Q.37 $T_{1/2}\lambda = 0.693$

$$\lambda = \frac{0.693}{T_{1/2}}$$

Q.38 [illegible]

Q.39 [illegible] $\frac{100}{2} = 50g$

Q.40 $E = \Delta mc^2$

$= 8.6\times10^{-30}\times9\times10^{16} = 77.4\times10^{-24}\,J$

$= \frac{77.4\times10^{-24}}{1.6\times10^{-19}}eV = 48.3\times10^{5}eV = 4.84MeV$

Q.41 $N = N_o\left(\frac{1}{2}\right)^n \Rightarrow 25 = 100\frac{1}{2^n} \Rightarrow \frac{1}{4} = \frac{1}{2^2} = \frac{1}{2^n} \Rightarrow n = 2$

$T = nT_{\frac{1}{2}} = 2\times1600 = 3200\,\text{years}$

Q.42 α-particle has maximum ionizing power.

Q.43 ${}^{180}_{72}X \xrightarrow{\alpha} {}^{176}_{70}X_1 \xrightarrow{\beta} {}^{176}_{71}X_2 \xrightarrow{\alpha} {}^{172}_{69}X_3 \xrightarrow{\gamma} {}^{172}_{69}X_4$

Q.44 When an atom is from its constituent particles is binding energy.

Q.45 $A = \lambda N$

$= 8.3\times10^{-10}\times6.7\times10^{21} = 55.61\times10^{11} = 5.6\times10^{12}\,Bq.$

Q.46 $T_{\frac{1}{2}} = \frac{0.693}{\lambda} = \frac{0.693}{4.3\times10^{+3}} = 0.16\times10^{-3} = 1.6\times10^{-4}s$

Q.47 In relation $\lambda T_{\frac{1}{2}} = 0.693$, λ is decay constant.

Q.48 In fission reaction, the binding energy per nucleon of products is greater than reactants.

Q.49 Quark composition of proton is

$P = U + U - d$

$= \frac{2}{3} + \frac{2}{3} - \frac{1}{3} = 1$

POST-ASSESSMENT TEST

Note: Physics paper of MDCAT contains 44 questions.

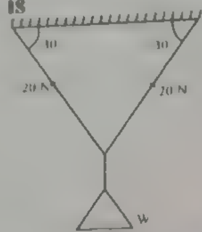
Q.1 Which one of the following is smallest quantity?

A) 0.01 g
B) 2 mg
C) 100 mg
D) 5000 mg

Q.2 The formula for electric field strength is E = F/Q, where E is electric field strength, F is force and Q is charge. Which of the following options gives the correct base units for electric field strength?

A) kg m s^{-3} A^{-1}
B) kg^2 m^{-1} s^2 A
C) kg s^{-2} A^{-2}
D) m^2 s^{-1} A^{-1}

Q.3 Unknown weight as shown in figure is



A) 10 N
B) 40 N
C) 20 N
D) 15 N

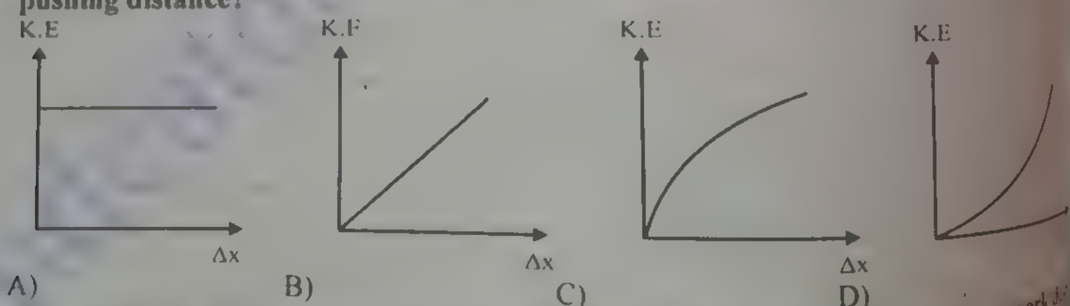
Q.4 With same initial velocity a body is thrown at angles 15°, 30°, 45°, 60°. At which two angles ranges are in ratio 1 : 2

A) 15° and 30°
B) 15° and 60°
C) 15° and 45°
D) 30° and 60°

Q.5 Two bodies are moving in opposite direction with velocity v. The magnitude of their relative velocity is

A) 0
B) 2 v
C) v
D) $\frac{v}{2}$

Q.6 A student applies force to a stalled car over a distance Δx to increase its kinetic energy. Which graph best represents the relationship between the kinetic energy and the pushing distance?



Q.7 If a certain force acts on an object and changes its K.E from a 65 J to 130 J, then work done by the force will be

A) 92.5 J
B) 97.5 J
C) 65 J
D) 130 J

Q.8 Slope of work time graph is equal to

A) Acceleration
B) Energy
C) Power
D) Momentum

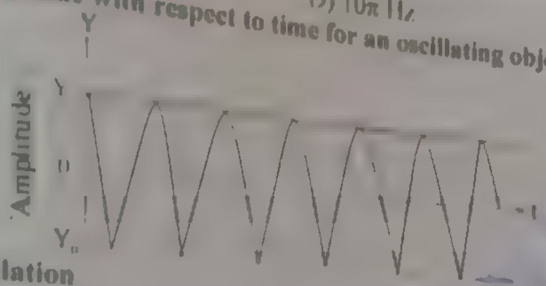
Q.9 **Time period of satellite is 6 h. If separation between the earth and the satellite is increased four times the previous value, the new time period will be**

A) [illegible]
B) [illegible]
C) 24 h
D) 1 h

Q.10 **A body is moving in a circle with period of 20π. What is angular frequency of body**

A) 0.1 Hz
B) 100 Hz
C) 2 Hz
D) 10π Hz

Q.11 **Variation of amplitude with respect to time for an oscillating object is shown in figure.**



Identify the oscillation

A) Damped
B) Critical
C) Un-damped
D) Heavily damped

Q.12 **The time period of spring mass system can also be defined as**

A) $2\pi\sqrt{g/x}$
B) $\pi\sqrt{g/x}$
C) $\pi\sqrt{x/g}$
D) $2\pi\sqrt{x/g}$

Q.13 **A simple harmonic oscillator has a time period of 10 seconds. Which equation relates its acceleration a and displacement x?**

A) a = - 10 x
B) a = $-(20\pi)^2$x
C) a = $-(20\pi)$ x
D) a = $-(2\pi/10)^2$x

Q.14 **In stationary wave of wavelength 0.4 m the distance between node and antinodes is**

A) 0.1 m
B) 0.4 m
C) 0.2 m
D) 0.5 m

Q.15 **The minimum length of tube open at both ends that resonates with frequency of 350 Hz if v = 350 m s^{-1}.**

A) 1 m
B) $\frac{1}{2}$ m
C) 2 m
D) $\frac{1}{14}$ m

Q.16 **Fringe width will be maximum for ________ light.**

A) Green
B) Red
C) Blue
D) Yellow

Q.17 **The value of critical angle for the glass-air boundary is**

A) 41.8^0
B) [illegible]
C) 41.5
D) 42.8

Q.18 **The relation 'PV = nRT' shows which law of physics?**

A) [illegible] law
B) [illegible] law
C) Newton's constant
D) Ideal gas law

Q.19 **The rapid escape of air from a burst tyre is an example of**

A) Adiabatic processes
B) Isothermal process
C) Cooling process
D) First law of thermodynamics

Q.20 Which relation exactly described the isothermal process

A) $Q = W$

C) $Q = \Delta U$

B) $W = \Delta U$

D) $Q = \Delta U + W$

Q.21 The work done in moving a unit positive charge from one point to another against the electric field is a measure of

A) Capacitance

C) Intensity of electric field

B) Potential difference between two points

D) Resistance between two points

Q.22 Energy density in case of a capacitor is always proportional to

A) E^2

C) V^2

B) ε_0

D) C

Q.23 The capacitance of a parallel plate capacitor is given by

A) $C = \frac{A}{\varepsilon_0 d}$

C) $C = \frac{A\varepsilon_0}{d}$

B) $C = \frac{\varepsilon_0 d}{A}$

D) $C = \frac{d}{\varepsilon_0 A}$

Q.24 Let an emf of 120 volt of negligible internal resistance connected across a resistance of 1000 ohm. Then the current flowing through the circuit will be

A) 120 A

C) 120×10^3 A

B) 120×10^{-3} A

D) 12×10^3 A

Q.25 Three resistors each of 3 Ω are connected to form a triangle resistance between any two terminals is

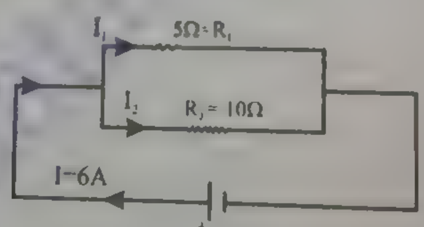
A) 2 Ω

C) 1 Ω

B) 3 Ω

D) 9 Ω

Q.26 The current flowing through R_1 and R_2 will be



A) 4 A, 2 A

C) 2 A, 4 A

B) 3 A, 3 A

D) 6 A, 6A

Q.27 An electron is moving along the axis of a solenoid carrying a current. Which of the following is a correct statement about the electromagnetic force acting on the electron?

A) The force acts radially inwards

B) The force acts radially outwards

C) The force acts in the direction of motion

D) No force acts

Q.28 If we doubled all the parameters of the force acting on current carrying conductor at $\theta = 90°$ then magnetic force becomes

A) Half

C) Eight times

B) Double

D) Four times

Q.29 Direction of magnetic field due to straight current carrying conductor is given by

A) Fleming left hand rule

C) Right hand rule

B) Ampere's law

D) Joule's law

The number of turns in the primary and secondary coils of a transformer are 100 and 300 respectively. If the input power is 60 W. The output power will be

A) [illegible] W

B) [illegible] W

C) 60 W

D) 90 W

A straight copper wire is moved in a uniform magnetic field such that it cuts the magnetic lines of force. Then

A) emf will not be induced

B) emf will be induced

C) Sometimes emf will be induced and sometimes not

D) Nothing can be predicted

Q.32 The Lenz's law refers to induce

A) emf

B) Resistance

C) Current

D) Capacitance

Q.33 support a load of 'w' is cut into two equal parts the maximum load that can be supported by either part is

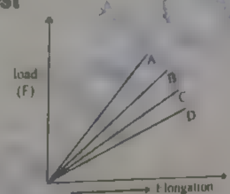
A) 2 w

B) $\frac{W}{2}$

C) w

D) $\frac{w}{4}$

Q.34 The load verses elongation graph for four wires of the same material is as shown in figure, which of the wire is thickest



A) A

B) C

C) B

D) D

Q.35 A close loop gain of OP-amplifier depends on

A) Internal structure of OP-amplifier

B) Externally connected resistance

C) Voltage power supplies

D) Input resistance

Q.36 A signal that is applied at the inverting input terminal of an op-amplifier undergoes amplification, at the output terminal with a phase shift of

A) 0

B) 270°

C) 360°

D) 180°

Q.37 The method by which only one half of A.C cycle is converted into direct current is called

A) Half wave amplification

B) Half wave rectification

C) Full wave rectification

D) Full wave amplification

Q.38 If the threshold frequency of incident light for a metal surface is f_o, its work function (ϕ) will be:

A) $\phi = hf$

B) $\phi = h(f+f_o)$

C) $\phi = hf_o$

D) $\phi = h(f-f_o)$

Q.39 λ_{min} of X-rays tube depends on the

A) Filament current

B) Atomic number of target

C) Voltage applied to tube

D) Nature of tube

Q.40 An electron makes transition from $n = 4$ to $n = 1$ state in a hydrogen atom. The maximum possible number of photons emitted will be

A) 1
B) 3
C) 2
D) 6

Q.41 Davisson determine the wavelength of scattered electron from the relation:

A) $\lambda = \dfrac{h}{2mVe}$
B) $\lambda = \dfrac{2h}{\sqrt{mVe}}$
C) $\lambda = \dfrac{h}{2\sqrt{2mVe}}$
D) $\lambda = \dfrac{h}{\sqrt{2mVe}}$

Q.42 Unit of decay constant is

A) s
B) m^{-1}
C) m
D) s^{-1}

Q.43 The neutrons is assumed to be made up of

A) One up quark and two down quark
B) Two up quark and Two down quark
C) Two up quark and one down quark
D) One up quark and one down quark

Q.44 A certain radioactive mass decays from 64 gm to 2 gm in 20 days. What is its half-life?

A) 5 days
B) 4 days
C) 3 days
D) 5 days

ANSWER KEY

1	B	11	C	21	B	31	B	41	D
2	A	12	D	22	A	32	C	42	D
3	C	13	D	23	C	33	C	43	A
4	C	14	A	24	B	34	A	44	B
5	B	15	B	25	A	35	B		
6	B	16	B	26	A	36	D		
7	C	17	A	27	D	37	B		
8	C	18	D	28	C	38	C		
9	A	19	A	29	C	39	C		
10	A	20	A	30	C	40	D		

EXPLANATORY NOTES

Q.1 [illegible] $g) < 0.01g < 100mg(0.1g) < 5000mg(5g)$

Q.2 $E = \frac{F}{Q} = \frac{kgms^{-2}}{As} = Kgms^{-3}A^{-1}$ [illegible]

Q.3 $2T\sin\theta = w$

$w = 2(20)\sin 30^\circ$

$w = 20\,N$

Q.4 $R \propto \sin 2\theta$

$$\frac{R_1}{R_2} = \frac{\sin 2(15)}{\sin 2(45)} = \frac{1/2}{1} = 1:2$$

Q.5 For opposite direction $v_{rel} = v_1 + v_2 = v + v = 2v$

Q.6 $W = \Delta K.E$

$\Delta K.E = Fd$

$\Delta K.E \propto d$

Q.7 $W = \Delta K.E = 130 - 65 = 65\,J$

Q.8 Slop $= \frac{\Delta y}{\Delta x} = \frac{W}{t} = \text{power}$

Q.9 $T \propto r^{3/2}$ (initially)

$T' \propto (4r)^{3/2}$

$T' \propto 8r^{3/2}$

$T' = 8T$ from eq(1)

Q.10 $\omega = \frac{2\pi}{T} = \frac{2\pi}{20\pi} = 0.1$

Q.11 In undamped oscillation amplitude remain unchanged.

Q.12 For vertical mass spring system $T = 2\pi\sqrt{x/g}$

Q.13 $a = -x\omega^2$

$$a = -x\left(\frac{2\pi}{T}\right)^2 = -x\left(\frac{2\pi}{10}\right)^2$$

Q.14 Distance between node and antinode is $\frac{\lambda}{4} = \frac{0.4}{4} = 0.1$

Q.15 $v = f\lambda \rightarrow \lambda = \frac{v}{f} = \frac{350}{350} = 1$

For open pipe $\lambda_1 = 2l \rightarrow l = \frac{1}{2} m$

Q.16 $\Delta y \propto \lambda$

Q.17 For glass air boundary $\theta_c = 41.8^\circ$

Q.18 PV = nRT. It is ideal gas law.

Q.19 Adiabatic process is a rapid process.

Q.20 In isothermal process $\Delta U = 0$

$Q = \Delta U + W$

$Q = W$

Q.21 $V = \frac{W}{q}$

Q.22 $U = \frac{1}{2}\varepsilon_0\varepsilon_r E^2 \Rightarrow U \propto E^2$

Q.23 $C = \frac{A\varepsilon_o}{d}$

Q.24 $I = \frac{E}{R} = 120 \times 10^{-3} A$

Q.25 $R_{eq} = \frac{(6)(3)}{6+3} = 2\Omega$

Q.26 Current dividing rule $I_1 = \frac{R_2}{R_1 + R_2} I_{total} = \frac{10}{15} \times 6 = 4A$

$I_2 = \frac{R_1}{R_1 + R_2} I_{total} = \frac{5}{15} \times 6 = 2A$

Q.27 $\vec{F} = qvB\sin\theta = 0$ here $\theta = 0^\circ$

Q.28 $F = ILB$ $\therefore \theta = 90^\circ$

$F' = (2I)(2L)(2B) = 8ILB = 8F$ (When all parameters becomes double)

Q.29 Direction of magnetic field due to straight current carrying conductor is given by Right hand rule.

Q.30 $P_{in} = P_{out}$ [Ideal transformer] $V_p I_p = V_s I_s$

Q.31 As wire cut magnetic field so, flux must very hence emf will induce

Q.32 Lenz's law refers to induce current

Q.33 UTS is independent of length of material.

Q.34 $Y = \frac{F}{A}\cdot\frac{l}{\Delta l} \Rightarrow \frac{F}{\Delta l} = \frac{YA}{l}$

And $\frac{F}{\Delta l} \propto A$

Q.35 $G = 1 + \frac{R_2}{R_1}$ or $G = -\frac{R_2}{R_1}$

Q.36 $G = -\frac{R_2}{R_1}$ -ve sign indicate phase shift of 180°.

Q.37 In half wave rectification only one half cycle change into D.C.

Q.38 $\phi = hf_0$

Q.39 $hf_{max} = Ve \Rightarrow \frac{hc}{\lambda_{min}} = Ve;\ \lambda_{min} \propto \frac{1}{V}$

Q.40 Number of spectral lines $= \frac{n(n-1)}{2} = \frac{4(4-1)}{2} = 6$

Q.41 According to Davison and Germer Experiment $\lambda = \frac{h}{\sqrt{2meV}}$

Q.42 $\lambda = \frac{\Delta N / No}{\Delta t}$ $\therefore$ unit $= s^{-1}$

Q.43 Neutron $= \frac{2}{3} - \frac{1}{3} - \frac{1}{3} = 0$ (one up and two down quarks)

Q.44 Remaining atoms $= \frac{\text{Orignal atoms}}{2^n}$

$2^n = \frac{64}{2} = 32$

$n = 5$

5 half-lives in 20 days

So, half-life $= \frac{20}{5} = 4$ days

Self Assessment Tests

UNIT WISE

1 UNIT

MEASUREMENTS

SELF ASSESSMENT TEST

Q.1 The SI unit of intensity of light is equal to the which one of the followings?

A) Watt
B) Ampere
C) Kelvin
D) Candela

Q.2 The correct unit of Viscosity in SI system is

A) rad s^{-2}
B) gs^{-2}
C) N sm^{-2}
D) $m^2\ s^{-1}$

Q.3 Measurement which is close to the true value is

A) accurate
B) precise
C) average
D) error

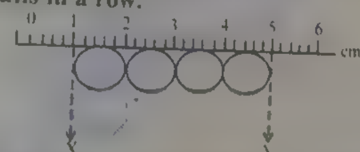
Q.4 By using prefixes, we can write 335×10^{-8} s as

A) 0.335 μs
B) 335 μs
C) 33.5 μ
D) 3.35 μs

Q.5 A student claimed that diameter of a wire is 1.042 using vernier callipers. Upto what extent he is right?

A) 1 cm
B) 1.0 cm
C) 1.04 cm
D) 1.042 cm

Q.6 The student attempt to measure the diameter of a steel ball by using meter rule to measure four similar balls in a row.



The student estimate the positions on the scale to be as follows.

X (1.0 ±0.2) cm

Y(5.0 ±0.2) cm

What is the diameter of a steel ball together with its associated uncertainty?

A) (1.0 ±0.05) cm
B) (1.0 ±0.2) cm
C) (1.0 ±0.1) cm
D) (1.0 ±0.24) cm

Q.7 Steradian is a unit of

A) Plane angle
B) Charge
C) Solid angle
D) Resistance

Q.8 The unit of $\frac{1}{\sqrt{LC}}$ is same as that of

A) R
B) f
C) I
D) V

Q.9 The change in velocity of a body is $(12.5 \pm 0.2)ms^{-1}$ in a time (5.0 ± 0.3)sec. Find percentage uncertainty in average value of acceleration.

A) 6%
B) 7.6%
C) 8%
D) 1.6%

Q.10 Which of the following is not SI base quantity?

A) Temperature
B) Mole
C) Length
D) Current

Q.11 Silicon is abundantly obtained from

A) [illegible]
B) Metal
C) Sand
D) Stones

Q.12 The electric field is $E = \frac{F}{q}$ then the correct unit for electric field strength is

A) $Kg\ m\ s^{-3}\ A^{-1}$
B) $Kg\ m^{-1}\ s^{-2}\ A^{-1}$
C) $Kg\ m^{-1}\ s^{-3}\ A^{-2}$
D) $Kg\ m^{-1}\ s^{-3}\ A^{-1}$

Q.13 The units of R/L is same as

A) decay rate
B) Frequency
C) decay constant
D) All of these

Q.14 Which of the following gives the prefixes in increasing order

A) Giga, mega, micro
B) Micro, mega, pico, giga
C) Pico, micro, mega, giga
D) Giga, mega, pico, micro

Q.15 One nanometre is equal to

A) 10^{-9} mm
B) 10^{-7} cm
C) 10^{-6} cm
D) 10^{9} cm

Q.16 If 'h' is the height and 'g' is the acceleration due to gravity, then the unit of $\sqrt{\frac{2h}{g}}$ is the same as that of

A) Time
B) Mass
C) Volume
D) Velocity

Q.17 The dimensional formula of PV, where P is pressure and V is volume is the same as that of

A) Work
B) Power
C) Elastic modulus
D) Pressure

Q.18 The e.m.f induced in a coil by a changing magnetic flux is equal to the rate of change of flux with time. Which is the unit for magnetic flux?

A) $kg\ m^2 s^{-2} A^{-1}$
B) $kg\ m^2 s\ A^{-1}$
C) $kg\ m^2 s^{-2} A$
D) $ms^{-2} A^{-1}$

Q.19 Which of the following pairs of units are both SI base units?

A) Ampere, degree celsius
B) Coulomb, degree celsius
C) Ampere, kelvin
D) Coulomb, kelvin

Q.20 What is the ratio of $\frac{1\mu m}{1Gm}$?

A) 10^{-3}
B) 10^{-12}
C) 10^{-9}
D) 10^{-15}

Q.21 Which of the following is least multiple?

A) deca
B) micro
C) peta
D) deci

Q.22 Which physical quantity have same units in all systems of units?

A) Length
B) Time
C) Mass
D) Power

Q.23 In SI number of physical quantities are

A) [illegible]
B) 2
C) 3
D) Infinite

Q.24 Choose the pair in decreasing order:
A) centi, mili, micro
B) deca, kilo, mega
C) micro, mili centi
D) kilo, mega, deca

Q.25 The least count of stop watch is $\frac{1}{5}$ sec. The time of 20 oscillations of a pendulum is measured to be 25 sec. The minimum percentage error in measurement of time will be
A) 0.1%
B) 0.8%
C) 1.8%
D) 8%

Q.26 The error in the measurement of the radius of a sphere is 1%. The error in the measurement of its volume is
A) 1%
B) 5%
C) 3%
D) 8%

Q.27 A stop watches accurate up to 1/100 of a second, the absolute uncertainty of the watch is
A) 0.1s
B) 0.01s
C) 0.2s
D) 1s

Q.28 Which of the following is unit less?
A) sin θ
B) frequency
C) θ
D) both A and C

Q.29 The equation relating pressure and density is $p = \rho gh$. How can both sides of this equation be written in term of base units?
A) $[Nm^{-1}] = [kg\,m^{-3}][ms^{-1}][m]$
B) $[kg\,m^{-1}s^{-2}] = [kg\,m^{-3}][ms^{-2}][m]$
C) $[Nm^{-2}] = [kg\,m^{-3}][ms^{-2}][m]$
D) $[kg\,m^{-3}] = [ms^{-2}][m]$

Q.30 The percentage error in the measurement of mass and speed are 5% and 6% respectively. The maximum error in the measurement of momentum is:
A) 11%
B) 30%
C) 15%
D) 90%

Q.31 The unit of percentage error is
A) percentage error is unit less
B) errors have got their own units which are different from that of physical quantity measured
C) different from that of physical quantity
D) same as that of physical quantity

Q.32 The mean time period of second's pendulum is 2.00s and mean absolute error in the time period is 0.05s. To express maximum estimate of error, the time period should be written as
A) (2.00 ± 0.01) s
B) (2.00 ± 0.10) s
C) (2.00 ± 0.05) s
D) (2.00 +0.025) s

Q.33 The unit of relative permeability is
A) Henry/volt
B) unitless
C) Henry
D) Farad/m

Q.34 The SI unit of Couple arm
A) kilo meter
B) milli meter
C) centi meter
D) meter

Q.35 The ratio of unit of RC to the frequency is
A) sec^2
B) sec
C) unitless
D) sec

Q.36 Which of the following is not a correct representation method for prefixes

A) 1 mm
B) 1000 μm
C) 10 km
D) both "A" and "B"

Q.37 **The unit of moment of Inertia is**

A) $kg\ m^2$
B) $kg\ m^{-2}$
C) $kg^{-1}\ m^2$
D) $kg^{-2}\ m^{-1}$

Q.38 **The unit of $\sqrt{\frac{g}{l}}$ is similar to the**

A) decay constant
B) time period
C) angular frequency
D) both A and B

Q.39 **An experiment measured quantities a, and b and then x is calculated from $x = ab$. If the percentage errors in a, b are $+1\%$, and $+3\%$ respectively, the percentage error in x can be:**

A) $\pm 13\%$
B) $\pm 4\%$
C) $\pm 7\%$
D) $\pm 1\%$

Q.40 **Which one is a base quantity:**

A) kilogram
B) kelvin
C) conventional current
D) charge

Q.41 **The magnitude of any physical quantity**

A) depends on the method of measurement
B) does not depend on the method of measurement
C) is more in S-I system than in CGS system
D) directly proportional to the fundamental unites of mass, length and time.

Q.42 **Which of the following is not equal to watt**

A) $J\ s^{-1}$
B) Amp x volt
C) $(Amp)^2 \times ohm$
D) Amp/volt

Q.43 **A physical quantity is related to four variables a,b,c and d as follows, $A =$ [illegible] percentage error of measurement in a,b,c and d are 1%, 3%, 2% and 2% respective What is the percentage error in the quantity A**

A) 12%
B) 7%
C) 5%
D) 14%

Q.44 **According to Joule's law of heating, heat produced $H = I^2 Rt$, where I is current, R resistance and t is time. If the error in the measurement of I, R and t are 3%, 4% and 6% respectively then error in the measurement of H is**

A) 17%
B) 16%
C) 19%
D) 25%

Q.45 **We have error in the measurement of length, radius, mass and current of a wire are 3%, 2% and 1% then error in its density will be**

A) 11%
B) 8%
C) 10%
D) 7%

Q.46 **The Bernoulli's equation is given by $p + \frac{1}{2}\rho v^2 + \rho gh = constant$ the quantity the same units as that of**

A) force
B) [illegible]
C) strain
D) pressure

Q.47 Which one is not a branch of physical sciences?
A) chemistry
B) astronomy
C) geology
D) biology

Q.48 The resistance R of a wire is given by the relation $R = \frac{\rho l}{\pi r^2}$. Percentage error in the measurement of ρ, l and r is 1%, 2% and 3% respectively. Then the percentage error in the measurement of R is
A) 6%
B) 9%
C) 8%
D) 10%

Q.49 Which of the following quantities can be written in SI unit in $kgm^2A^{-2}s^{-3}$?
A) Resistance
B) Inductance
C) Capacitance
D) Magnetic flux

Q.50 Wave length of visible light is 0.00006 m then it is =...
A) 6 microm
B) 60 micron
C) 600 micron
D) 0.6 micron

Q.51 In an experiment four quantities a, b, c and d are measured with percentage error 1%, 2%, 3% and 4%respectively. Quantity P is calculated as follows:

$P = \frac{a^3 b^2}{cd}$ Percentage error in P is
A) 14%
B) 10
C) 7%
D) 4%

Q.52 Two resistances $R_1 = (4.0 \pm 0.4)k\Omega$ and $R_2 = (3.0 \pm 0.3)k\Omega$ are connected in parallel. The percentage error in the equivalent resistance is
A) 7%
B) 9%
C) 18%
D) 30%

Q.53 Three base units in S.I units are
A) gram, Joule and second
B) gram, centimeter and dyne
C) second, kg and Newton
D) None

Q.54 The base units of the SI system include those of
Mass, kg; length, m; time, s; electric current, A.
Which base units would be needed to express the SI unit of potential difference (the volt)?
A) kg and A only
B) m and A only
C) m, s, and A
D) kg, m, s and A

Q.55 Newton's second is the unit of
A) Velocity
B) Angular momentum
C) Momentum
D) Energy

Q.56 A micron is related to centimetre as
A) 1 micron = 10^{-8}cm
C) 1 micron = 10^{-5}cm
C) 1 micron = 10^{-6}cm
D) 1 micron = 10^{-4} cm

Q.57 In $S = a + bt + ct^2$. S is measured in metres and t in seconds. The unit of c is
A) ms^{-2}
B) ms^{-1}
C) m
D) None

Q.58 The average wavelength of yellow light emitted from a sodium lamp is 5893 Å. Express it in nm.

A) 5893 C) 58.9[illegible]

B) 589.3 D) [illegible]

Q.59 The error in measurement of radius of sphere is [illegible]%. What is permissible error in measurement of surface area

A) 0.4% C) 0.8[illegible]

B) 0.6% D) 0.08%

Q.60 Accuracy of measurement is determined by

A) Absolute error C) Both

B) Percentage error D) None of these

ANSWER KEY

1	D	11	C	21	B	31	A	41	B	51	A
2	C	12	A	22	B	32	C	42	D	52	D
3	A	13	D	23	D	33	B	43	D	53	D
4	D	14	C	24	A	34	D	44	B	54	D
5	C	15	B	25	B	35	A	45	C	55	C
6	C	16	A	26	C	36	B	46	D	56	D
7	C	17	A	27	B	37	A	47	D	57	A
8	B	18	A	28	A	38	A	48	B	58	B
9	B	19	C	29	B	39	C	49	A	59	C
10	B	20	D	30	A	40	C	50	B	60	B

2

UNIT

MOTION AND FORCE

SELF ASSESSMENT TEST

A particle goes from x = 2m, y = 3m, z = 1m to x = 3m, y = −1m, z = 4m. Its displacement is:

A) $(1m)\hat{i} - (2m)\hat{j} + (5m)\hat{k}$
C) $(5m)\hat{i} - (4m)\hat{j} + (3m)\hat{k}$
B) $(5m)\hat{i} + (4m)\hat{j} - (3m)\hat{k}$
D) $-(1m)\hat{i} - (2m)\hat{j} - (5m)\hat{k}$

A 40 N block is supported by two ropes. One rope is horizontal and the other makes an angle of 30° with the ceiling. The tension in the rope attached to the ceiling is approximately

A) 80 N
C) 40 N
B) 34.6 N
D) 46.2 N

A force of 120 N is applied perpendicularly on a spanner at a distance of 9 cm from a nut. torque produced by force will be

A) 12 Nm
C) 10.8 Nm
B) 15 Nm
D) 12.59 Nm

Q.4 A shell explodes into four unequal parts. Which one of the following is conserved?

A) Potential energy
C) Kinetic energy
B) Momentum
D) Both potential and kinetic energy

Q.5 A projectile is fired horizontally with an initial speed of 20 m/s. Its horizontal speed 3s later is

A) 20 m/s
C) 6.67 m/s
B) 60 m/s
D) 29.4 m/s

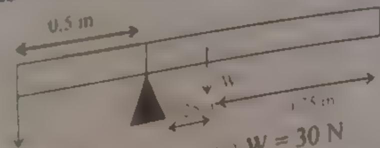
Q.6 A body of moment of inertia I = 0.80 kg m² about a fixed axis, rotating with constant angular velocity of 100 rad s⁻¹, then torque acting on it will be

A) 80 Nm
C) 100 Nm
B) Zero
D) 120 Nm

Q.7 If distance of a point from pivot is 'l' and a force 'F' in applied such that it passes from the pivot, then the torque produce in the body will be

A) F
C) $lF\cos\theta$
B) $lF\sin\theta$
D) Zero

Q.8 A rod is in equilibrium as shown in figure. What can be the weight of this rod?

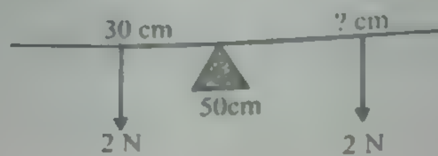


A) W = 300 N
C) W = 30 N
B) W = 20 N
D) W = 200 N

Two objects "A" and "B" are such that body "A" is rotating with uniform angular speed of 2 rad s⁻¹ while "B" with uniform acceleration of 2 rad s⁻². If the ratio of their moment of inertia $I_A : I_B$ = 2:1, then what is the ratio of τ_A and τ_B?

C) 1:2
D) ∞
B) Zero

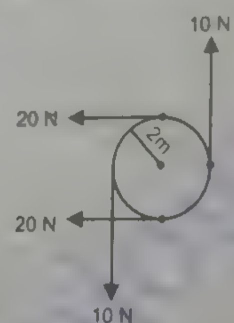
Q.10 A uniform beam of 1m is supported at the 50 cm mark. Given that a weight of 2 N hangs at the 30 cm mark, at which position must another weight of 2 N be hung to balance the beam?



A) 70 cm
B) 50 cm
C) 20 cm
D) 30 cm

Q.11 Which law of motion defines force?
A) 1st law
B) 3rd law
C) 2nd law
D) All of these

Q.12 Four forces acting on a circular object as shown in fig. The net resultant torque about 'O' is, where radius r=2 m.



A) Zero
B) 20 Nm
C) 40 Nm
D) 80 Nm

Q.13 A Force of 12 N gives an object an acceleration of 4 m/s^2. The force required to give it an acceleration of 10 m s^{-2} is
A) 15 N
B) 20 N
C) 25 N
D) 30 N

Q.14 Length of the path of a particle is equal to the magnitude of the displacement of the particle. Shape of the path possible
A) Circle
B) Parabola
C) Arc of a circle
D) Straight line

Q.15 For which one of the following pair of projection angle the horizontal range will be the same
A) 45°,55°
B) 27°,63°
C) 58°,64°
D) 33°,85°

Q.16 For which of the following angles range is maximum?
A) 43°
B) 60°
C) 30°
D) None

Q.17 The shortest distance between two points is called
A) acceleration
B) speed
C) velocity
D) displacement

Q.18 A bullet is fired horizontally from a rifle at a distant target. Ignoring the effect of air resistance, what is the horizontal and vertical acceleration of the bullet?

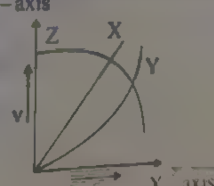
Horizontal	Vertical
A) $9.8\ ms^{-2}$	$9.8\ ms^{-2}$
B) $9.8\ ms^{-2}$	$0\ ms^{-2}$
C) 0	$9.8\ ms^{-2}$
D) 0	0

Q.19 What give the value of a body acceleration?
A) The area under its displacment graph
B) The area under its velocity-time graph
C) The gradient of its displacment time graph
D) The gradient of its velocity time graph

Q.20 A football of mass 0.4 kg at rest acquires a speed of 20 m/sec when kicked. What is the impulse imparted to ball?
A) 4 N. sec
B) 5 N. sec
C) 2 N sec
D) 8 N sec

Q.21 The velocity of projectile at its maximum height is
A) Zero
B) Minimum
C) Maximum
D) In between maximum and minimum

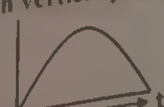
Q.22 Which of the following v-t curves has increasing acceleration?



A) X
B) Z
C) Y
D) Both Y and Z

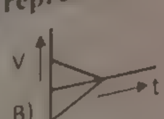
Q.23 When a force of 5 N acts on a mass of 3 Kg for a time of 2 sec. What is the rate of change of momentum?
A) $5\ Kg\ m/sec^2$
B) $410\ Kg\ m/sec^2$
C) $2.5\ Kg\ m/sec^2$
D) $6\ Kg\ m\ sec^{-2}$

Q.24 Displacement time graph of a ball thrown vertically upward is shown in figure

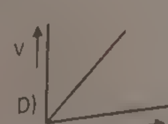


Which of the following represents v-t graph?

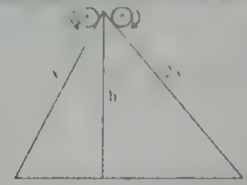
A)


B)


C)


D)


Q.25 Two identical discs slip from top of two identical planes of slant length x and 2x but height h is same as shown in figure. The velocities V_1 and v_2 acquired by the discs when they reach the bottom of the incline, are related as (neglecting all frictional effects)



A) $v_1 = v_2$
B) $v_1 = 2v_2$
C) $2v_1 = v_2$
D) none of these

Q.26 **Which one is the correct relation**

A) $a = \frac{V_f - V_i}{2t}$
B) $a = \frac{2(S - V_i t)}{t^2}$
C) $a = \frac{V_f^2 + V_i^2}{2S}$
D) $a = \frac{(S + V_i t)}{2t^2}$

Q.27 **If the slope of a velocity time graph gradually decreases then the body is said to be moving with**

A) Positive acceleration
B) Uniform velocity
C) Negative acceleration
D) None of these

Q.28 **An aeroplane is flying horizontally at a velocity v. It drops a packet from a height h. the time taken by the packet to reach the ground will be**

A) $\sqrt{\frac{2h}{g}}$
B) $\sqrt{\frac{h}{2g}}$
C) $\sqrt{\frac{2v}{g}}$
D) $\sqrt{\frac{v}{h}}$

Q.29 **A graph is drawn with force along Y-axis and time along X-axis. The area under the graph represents**

A) Momentum
B) Momentum of the force
C) Couple
D) Impulse of the force

Q.30 **Two cars are moving in opposite directions with speed v. What is the magnitude of the relative velocity?**

A) 0
B) v/2
C) v
D) 2v

Q.31 **When the net torque acting on a system is zero, which of the following will be constant**

A) angular momentum
B) velocity
C) force
D) linear momentum

Q.32 **What is the angle of projection for which the range and maximum height become equal**

A) $\tan^{-1}\frac{1}{4}$
B) $\tan^{-1} 4$
C) $\cos^{-1}\frac{1}{4}$
D) $\sin^{-1}\frac{1}{4}$

Q.33 **A man in a car moving with velocity of 36 km/hr. His speed with respect to the car is**

A) 10 m/s
B) 36 m/s
C) zero
D) infinite

A car travelling at a speed of 30 km/hour is brought to a halt in 8 m by applying brakes. If the same car is travelling at 60 km/hour, it can be brought to a halt with the same [illegible] force in

A) 8 m
B) 16 m
C) 24 m
D) 32 m

A ball is thrown at the angle of 45° with the horizontal: Then

A) [illegible] of the ball is parabola and horizontal range in maximum
B) the path of the ball is a parabola and horizontal range is minimum
C) [illegible] path of ball is straight line and horizontal range is maximum
D) [illegible] path of the ball is semi-circle having maximum diameter

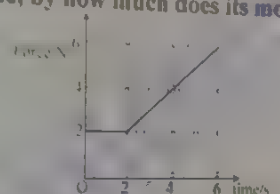
Q.36 An object dropped from the window of a tall building hits the ground in 12.0 s. If its acceleration is $9.80\ m/s^2$, the height of the window above the ground is

A) 706 m
B) 118 m
C) 353 m
D) 29.4m

Q.37 A book is lying on the table. What is the angle between the action of the book on the table and the reaction of the table on the book

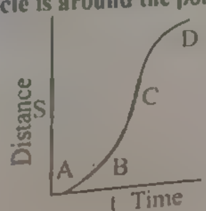
A) 90°
B) 180°
C) 60°
D) 45°

Q.38 The graph shows how the force acting on a body varies with time. Assuming that the body is moving in a straight line, by how much does its momentum change?



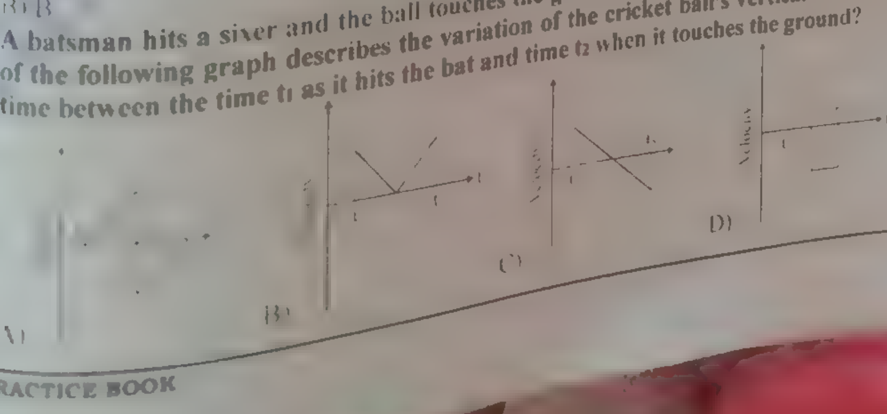
A) $40\ kg\ ms^{-1}$
B) $20\ kg\ ms^{-1}$
C) $36\ kg\ ms^{-1}$
D) $16\ kg\ ms^{-1}$

Q.39 A particle shows distance-time curve as given in this figure. The maximum instantaneous velocity of the particle is around the point



A) A
B) B
C) D
D) none

Q.40 A batsman hits a sixer and the ball touches the ground outside the cricket ground. Which of the following graph describes the variation of the cricket ball's vertical velocity v with time between the time t_1 as it hits the bat and time t_2 when it touches the ground?



A)
B)
C)
D)

Q.41 If a bullet of mass 5g moving with velocity 100 m/sec penetrates the wooden block upto 6cm. Then the average force imposed by the bullet on the block is
A) 8300 N
B) 417 N
C) 830 N
D) zero

Q.42 A force of 100 Dynes acts on mass of 5g for 10 sec. The velocity produced is____
A) 2 cm/sec
B) 20 cm/sec
C) 200 cm/sec
D) 2000 cm/sec

Q.43 A force of 50 Dynes is acted on a body of mass 5g which is at rest for an interval of 3 sec then impulse is
A) 0.15×10^{-3} N s
B) 0.98×10^{-3} N s
C) 1.5×10^{-3} N s
D) 2.5×10^{-3} N s

Q.44 A uniform rod 30 cm long is pivoted at its center. A 40 N weight is hung 5 cm from the left end. Where must a 50 N weight be hung to maintain equilibrium?
A) 5 cm from right end
B) 7 cm from right end
C) 6 cm from right end
D) 8 cm from right end

Q.45 A cannon after firing recoils due to
A) conservation of energy
B) Backward thrust of gases produced
C) Newton's third law of motion
D) Newton's first law of motion

Q.46 Whenever force acts perpendicularly to a moving body then
A) it's velocity increases
B) it's velocity neither increases nor decreases
C) it's velocity decreases
D) all of these

Q.47 An object is projected upward such that it moves freely under the action of gravity. If acceleration while going upward is assumed to be $a = -9.8\ ms^{-2}$ and while coming down is $a' = +9.8\ ms^{-2}$. What is the angle between 'a' and 'a'' = ?
A) 180°
B) 30°
C) 0°
D) can't be sure

Q.48 A book is lying on the table. What is the angle between the action of the book on the table and the reaction of the table on the book?
A) 0°
B) 45°
C) 45°
D) 180°

Q.49 One side of the seesaw carries a 21 kg mass four meter from the fulcrum and 25.5 kg mass two meter from the fulcrum. To balance the seesaw, what mass should be placed nine meter from the fulcrum on the side opposite the first two masses?
A) 45 kg
B) 15 kg
C) 12 kg
D) 18 kg

Q.50 Two masses hang below a massless meter stick. Mass 1 is located at the 10 cm mark with a weight of 15 kg, while mass 2 is located at the 60 cm mark with a weight of 30 kg. At what point in between the two masses must the string be attached in order to balance the system?
A) 53 cm
B) 29 cm
C) 43 cm
D) 35 cm

Q.51 A body can have constant velocity when it follows a.
A) elliptical path
B) circular path
C) parabolic path
D) rectilinear path

Q.52 Two stones A and B are thrown at angle of θ and $(90° - \theta)$ with the horizontal. The ratio of their horizontal ranges is
A) 1 : 1
B) $\tan\theta$: 1
C) $\tan^2\theta$: 1
D) 1 : $\tan\theta$

Q.53 In the previous question, the ratio of the time of flight is:
A) 1 : 1
B) $\sin\theta$: $\cos\theta$
C) $\tan^2\theta$: 1
D) 1 : $\tan\theta$

A ball is projected upwards with velocity of 100 m/sec. it will strike the ground in approximately (g = 10 m/sec²)

A) [illegible]
B) [illegible]
C) [illegible]
D) [illegible]

A boy leaves his house for a cycle ride. He comes back to his house after half an hour after covering a distance of one km. What is his average velocity for the ride?

A) [illegible] per hour
B) 2 km per hour
C) [illegible] km per second
D) 1/2 km per second

The collision between the two bodies is elastic if bodies are?

A) [illegible]
B) [illegible]
C) Solid and hard
D) Soft and elastic

A player throws a ball upwards with an initial speed of 29.4m/s. What is the direction of acceleration during the upwards motion of the ball?

A) Upwards
B) [illegible] motion
C) Diagonal
D) Vertically downwards

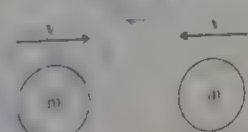
From a building 2 balls A and B are thrown such that A is thrown upward and B is thrown downward. If v_A and v_B are their respective velocities on reaching the ground, then

A) v_B is greater than v_A
B) v_B is lesser than v_A
C) $v_B = v_A$
D) Their velocities depend on their masses

When a very heavy ball 'B_1' collide with a stationary target 'B_2' of negligible mass, after collision the final velocity of ball 'B_2' will

A) become zero
B) become doubled as compared to B_1
C) become half
D) same as the B_1

Two similar spheres, each of mass m and traveling with speed v, are moving towards each other



The spheres have a head-on elastic collision. Which statement is correct?

A) The spheres stick together on impact.
B) The total kinetic energy before impact is zero
C) The total kinetic energy after impact is mv^2
D) The total momentum before impact is 2mv.

ANSWER KEY

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	C	11	A	21	B	31	A	41	B	51	D
2	A	12	C	22	D	32	B	42	C	52	A
3	C	13	D	23	A	33	C	43	C	53	B
4	B	14	D	24	C	34	D	44	B	54	A
5	A	15	B	25	A	35	A	45	C	55	A
6	B	16	A	26	B	36	A	46	B	56	C
7	D	17	D	27	A	37	B	47	C	57	D
8	D	18	C	28	A	38	B	48	D	58	C
9	B	19	D	29	D	39	B	49	B	59	B
10	A	20	D	30	D	40	C	50	C	60	C

3 UNIT — WORK, ENERGY, POWER & CIRCULAR MOTION

SELF ASSESSMENT TEST

Q.1 A force $\vec{F} = 5\hat{i} + 6\hat{j} - 4\hat{k}$ acting on a body, produces a displacement $\vec{S} = 6\hat{i} + 5\hat{k}$. Work done by the force is

A) 18 units
B) 12 units
C) 15 units
D) 10 units

Q.2 A force of 5 N acts on a 15 kg body initially at rest. The work done by the force during the first second of motion of the body is

A) 5 J
B) 6 J
C) $\frac{5}{6}$ J
D) 75 J

Q.3 A spring of force constant 10 N/m has an initial stretch 0.20 m. In changing the stretch to 0.25 m, the increase in potential energy is about

A) 0.1 joule
B) 0.3 joule
C) 0.2 joule
D) 0.5 joule

Q.4 A motor boat is travelling with a speed of 3.0 m/sec. If the force on it due to water flow is 500 N, the power of the boat is

A) 150 kW
B) 1.5 kW
C) 15 kW
D) 150 W

Q.5 Power of a water pump is 2 kW. If $g = 10\,m/sec^2$, the amount of water it can raise in one minute to a height of 10 m is

A) 2000 kg
B) 100 kg
C) 1000 kg
D) 1200 kg

Q.6 If the velocity of a body becomes half, the kinetic energy of body will become

A) One fourth
B) Four times
C) Double
D) Half

Q.7 In a gravitational field when work done by gravity is negative then

A) P.E increases
B) P.E remains same
C) P.E decreases
D) none

Q.8 Which of the following work is greater?

A) + 100 J
B) – 100 J
C) 0 J
D) Both A and B are equal

Q.9 The time taken by an engine of power 10 kW to lift a mass of 200 kg to a height of 40 m is ($g = 10\,ms^{-2}$)

A) 2 sec
B) 8 sec
C) 4 sec
D) 16 sec

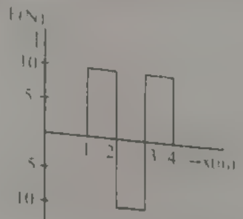
Q.10 If a body move along y-axis due to the application of force as shown in the figure then work is done by

A) $F \cdot \sin\theta$
B) F
C) $F s \cos\theta$
D) Both "B" & "C" are correct

A force "F_1" acts on a body through distance "S_1" in the direction of motion and does work "W_1", similarly another force "F_2" acts on same body through distance "S_2" but in opposite to the direction of motion and does work "W_2". Now if $F_1 = F_2$ and $S_1 = S_2$ then which statement is correct

A) $W_1 > W_2$
B) $W_1 = W_2$
C) $W_2 < W_2$
D) $W_1 = W_2 = 0$

The figure shows the force distance curve of a body moving along a straight line. The work done by the forces

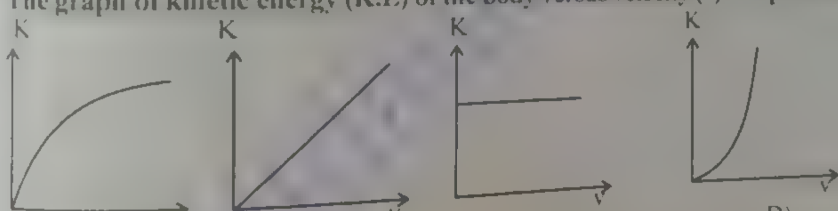


A) 10 J
B) 30 J
C) 20 J
D) 40 J

Q.13 The wounded spring of a clock possesses:
A) kinetic but no potential energy
B) potential but no kinetic energy
C) both potential and kinetic energy in equal amounts
D) neither potential nor kinetic energy

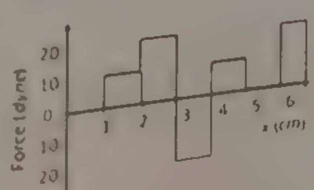
Q.14 An engine pump out 50 kg of water. If the water comes out vertically upwards with a velocity of 20 m/s. The power of engine is (take g= 10 m s^{-2})
A) 10 KW
B) 1000 W
C) 20 kW
D) 10 MW

Q.15 The graph of kinetic energy (K.E) of the body versus velocity (v) is represented by as



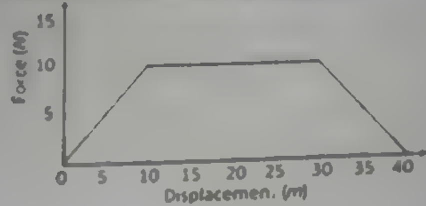
A) B) C) D)

Q.16 The relationship between force and position is shown in the figure given (in one dimensional case). The work done by the force in displacing a body from x = 1 cm to x = 5 cm is



A) 60 ergs
B) 700 ergs
C) 70 ergs
D) 20 ergs

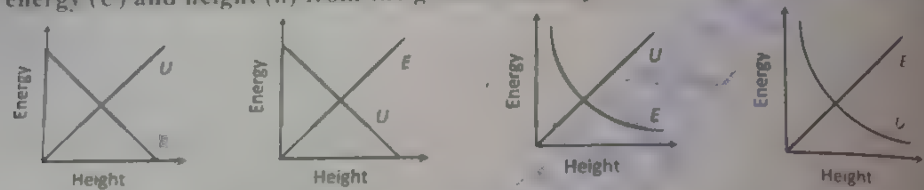
Q.17 Adjacent figure shows the force-displacement graph of a moving body, the work done in displacing body from $x = 0$ to $x = 35m$ is equal to



A) 25 J
B) 200 J
C) 287.5 J
D) 50 J

Q.18 When a person holding a pail by the force $\vec{F}$ is moving forward then the work being done on the pail is
A) maximum
B) negative
C) minimum
D) zero

Q.19 Which of the following graphs is correct between kinetic energy (E), potential energy (U) and height (h) from the ground of the particle



A) B) C) D)

Q.20 If the water falls from a dam into a turbine wheel 19.6 m below, then the velocity of water at the turbine is ($g=9.8\ m/s^2$)
A) 9.8 m/s
B) 19.6 m/s
C) 39.2 m/s
D) 98.0 m/s

Q.21 A body moving with velocity v has momentum and kinetic energy numerically equal. What is the value of v
A) 4 m/s
B) 2 m/s
C) $\sqrt{2}$ m/s
D) 0.2 m/s

Q.22 Work done on the body equals
A) Change in its K.E always
B) Change in its P.E always
C) Change in its K.E or change in its P.E
D) Neither change in K.E nor change in its P.E

Q.23 A block of mass m initially at rest is dropped from a height h on to a spring of force constant k. the maximum compression in the spring is x then

A) $mgh=1/2kx^2$
B) $mg(h+x)=1/2k(x+h)$
C) $mg(h+x)=1/2kx^2$
D) $mgh=1/2k(x+h)^2$

An electric motor exerts a force of 40 N on a cable and pulls it by a distance of 30 m in [illegible]. The power supplied by the motor (in Watts) is

[illegible]

A weight lifter lifts 300 kg from the ground to a height of 2 meter in 3 second. The average power generated by him is

[illegible]

B) 4410 watt

C) 2205 watt

D) [illegible]

Q.26 A car of mass 1000 kg accelerates uniformly from rest to a velocity of 54 km/hour in 5s. The average power of the engine during this period in watts is

[illegible]

Q.27 From an automatic gun a man fires 360 bullet per minute with a speed of 360 km/hour. If each weighs 20 g, the power of the gun is

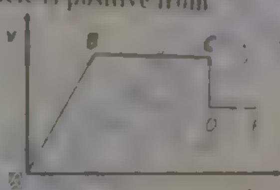
A) 75 W

B) 500 W

C) 300 W

D) [illegible] W

Q.28 The adjoining diagram shows the velocity versus time plot for a particle. The work done by the force on the particle is positive from



A) B to C

B) D to E

C) A to B

D) C to D

Q.29 A man does a given amount of work in 10 sec. Another man does the same amount of work in 20 sec. The ratio of the output power of first man to the second man is

A) 2 : 1

B) 1 : 2

C) 1

D) 4 : 1

Q.30 You lift a heavy book from the floor of the room and keep it in the book-shelf having a height 2 m. In this process you take 5 seconds. The work done by you will depend upon

A) mass of the book and time taken

B) weight of the book and height of the book-shelf

C) height of the book-shelf and time taken

D) mass of the book, height of the book-shelf and time taken

Q.31 Angular speed of a particle increases from 2 rad s^{-1} to 4 rad s^{-1} across any two diametrically opposite positions. Its angular acceleration will be ?

[illegible]

Q.32 When a body moves in a circle the angle between its velocity and angular velocity is always

[illegible]

Q.33 The moment of inertia of a flywheel are 4 kg m^2. A torque of 10 Nm is applied on it. The angular acceleration produced will be

A) 25 rad/ s^2 C) 2.5 rad/ s^2

B) 0.25 rad/ s^2 D) Zero

Q.34 The racing cars of masses m_1, and m_2 are moving in circles of radii r_1 and r_2 respectively. Their speeds are such that each makes a complete circle in the same length of time. The ratio of the angular speed of the first car to that of the second car is

A) $m_1 : m_2$ C) 1:1

B) $r_1:r_2$ D) $m_1 r_1 : m_2 r_2$

Q.35 Which of the following is the correct vector form of centripetal force

A) $m\omega\dot{r}$ C) $m\omega^2\dot{r}$

B) $-\frac{m\omega^2}{r}\hat{r}$ D) $-m\omega^2\dot{r}$

Q.36 Geo stationary satellite remains.

A) Stationary   C) Both "A" & "B"

B) Appears to remain stationary   D) None of them

Q.37 A body is moving in a circular path with constant speed. The magnitude of tangential and centripetal acceleration are

Tangential Acceleration	Centripetal Acceleration
A) $r v^2$	0
B) 0	0
C) 0	$\frac{v^2}{r}$
D) s	$\frac{v^2}{r}$

Q.38 A body rotates with uniform speed in a circle of radius r and takes time T to complete one revolution. What are the magnitudes of the angular velocity ω, the linear velocity v and the acceleration a?

Angular velocity, ω	Linear velocity, v	Acceleration, α
A) $\frac{1}{T}$	$\frac{4\pi r}{T}$	$\frac{2\pi r}{T^2}$
B) $\frac{2\pi}{T}$	$\frac{2\pi r}{T}$	$\frac{2\pi r}{T^2}$
C) $\frac{2\pi}{T}$	$\frac{2\pi r}{T}$	$\frac{4\pi^2 r}{T^2}$
D) $\frac{2\pi}{T}$	$\frac{4\pi r}{T}$	$\frac{4\pi^2 r}{T}$

A particle revolves round a circular path with a constant speed. The acceleration of the particle is

A) Along the circumference of the circle
B) Along the tangent
C) Along the radius
D) Zero

For a particle moving in uniform circular motion

A) Velocity is transverse and acceleration is radial
B) Velocity is radial and acceleration is transverse
C) Both velocity and acceleration are radial
D) Both velocity and acceleration are transverse

Q.41 The force which can do no work on the body on which it acts:

A) Frictional force
B) Gravitational force
C) Elastic force
D) Centripetal force

Q.42 The acceleration that is only due to change in direction of motion only is

A) Linear
B) Tangential
C) Angular
D) Centripetal

Q.43 The phase between linear velocity and angular velocity of a rotating body is

A) $\frac{\pi}{4}$
B) 2π
C) $\frac{\pi}{2}$
D) π

Q.44 The time period of Geo-stationary satellite is

A) 48 hours
B) 12 hours
C) 24 hours
D) 60 hours

Q.45 A body is moving in a circle of radius (r) with a variable speed, the acceleration of the body is:

A) Centripetal acceleration
B) Angular acceleration
C) Tangential acceleration
D) All of the above

Q.46 A particle of mass m is executing uniform circular motion on a path of radius r. If p is the magnitude of its linear momentum. The radial force acting on the particle is

A) mp^2/r
B) [illegible]
C) rm p
D) pmr

Q.47 The rotation period of an earth satellite close to the surface of the earth is 83 minutes. The time period of another earth satellite in an orbit at a distance equal to four times radius of earth from its surface will be

A) 83 minutes
B) 249 minutes
C) [illegible] minutes
D) [illegible] minutes

Q.48 A body revolved around the sun 27 times faster then the earth what is the ratio of their radii

A) [illegible]
B) [illegible]

Q.49 For a particle in a non-uniform accelerated circular motion

A) velocity is radial and acceleration is transverse only

B) velocity is transverse and acceleration has both radial and transverse components.

C) velocity is transverse and acceleration is radial only

D) velocity is radial and acceleration has both radial and transverse components.

Q.50 A body crosses the topmost point of a vertical circle with critical speed. Its centripetal acceleration, when the string is horizontal will be

A) 4g
B) g
C) 3g
D) 6g

Q.51 The period of a circular motion is given by

A) $T = r\,v$
B) $T = 2\pi\,\omega$
C) $T = \omega\, w$
D) $T = 2\pi/\omega$

Q.52 A cyclist turns around a curve at 15 miles/hour. If he turns at double the speed, the tendency to overturn is

A) quadrupled
B) unchanged
C) halved
D) doubled

Q.53 Two bodies of mass 10 kg and 5 kg moving in concentric orbits of radii R and r such that their periods are the same. Then the ratio between their centripetal acceleration is

A) R/r
B) R^2/r^2
C) r/R
D) r^2/R^2

Q.54 The ratio of angular speeds of minute hand and hour hand of a watch is

A) 6 : 1
B) 1 : 12
C) 12 : 1
D) 1 : 6

Q.55 A string breaks if its tension exceeds 10 newtons. A stone of mass 250 gm tied to this string of length 10 cm is rotated in a horizontal circle. The maximum angular velocity of rotation can be

A) 20 rad/s
B) 100 rad/s
C) 40 rad/s
D) 200 rad/s

Q.56 An electric fan has blades of length 30 cm as measured from the axis of rotation. If the fan is rotating at 1200 r.p.m. The acceleration of a point on the tip of the blade is about

A) $1600\ m/sec^2$
B) $2370\ m/sec^2$
C) $4740\ m/sec^2$
D) $5055\ m/sec^2$

Q.57 A body of mass 5 kg is moving in a circle of radius 1m with an angular velocity of 2 radian/sec. The centripetal force is

A) 10 N
B) 30 N
C) 20 N
D) 40 N

Q.58 The angular velocity of a particle rotating in a circular orbit 100 times per minute

A) 1.66 rad/s
B) 10.47 deg/s
C) 10.47 rad/s
D) 60 deg/s

The normal acceleration of a point on the rim of a 3 m diameter fly wheel is a constant 15 m/s². The angular speed of the fly wheel is (in radians/sec).

C) 2.6
D) 5.6

A point on the edge of a rotating disc of radius 8 m moves through an angle of 2 rad. The length of arc described by the point is

B) 16 m
C) 4 m
D) 4 rad

ANSWER KEY

1	D	11	B	21	B	31	B	41	D	51	D
2	C	12	A	22	C	32	D	42	D	52	A
3	A	13	B	23	C	33	C	43	C	53	A
4	B	14	A	24	B	34	C	44	C	54	C
5	D	15	D	25	D	35	D	45	D	55	A
6	A	16	D	26	B	36	B	46	B	56	C
7	A	17	C	27	D	37	C	47	C	57	C
8	D	18	D	28	C	38	C	48	B	58	C
9	B	19	B	29	A	39	C	49	B	59	A
10	A	20	B	30	B	40	A	50	C	60	B

4 UNIT — OSCILLATION AND WAVES

SELF ASSESSMENT TEST

Q.1 A particle executes S.H.M. with a period of 6 second and amplitude of 3 cm. Its maximum speed in cm/sec is

A) $\pi/2$
B) 2π
C) π
D) 3π

Q.2 A S.H.M. has amplitude 'a' and time period T. The maximum velocity will be

A) $\frac{4a}{T}$
B) $2\pi\sqrt{\frac{a}{T}}$
C) $\frac{2a}{T}$
D) $\frac{2\pi a}{T}$

Q.3 If a particle under S.H.M. has time period 0.1 *sec* and amplitude 2×10^{-3}m. It has maximum velocity

A) $\frac{\pi}{25}$ m/s
B) $\frac{\pi}{30}$ m/s
C) $\frac{\pi}{26}$ m/s
D) None of these

Q.4 The potential energy of a particle executing S.H.M. is 2.5 J, when its displacement is half of amplitude. The total energy of the particle be

A) 18 J
B) 12 J
C) 10 J
D) 2.5 J

Q.5 A body executes simple harmonic motion. The potential energy (P.E.), the kinetic energy (K.E.) and total energy (T.E.) are measured as a function of displacement x. Which of the following statements is true

A) P.E. is maximum when $x = 0$
B) T.E. is zero when $x = 0$
C) K.E. is maximum when $x = 0$
D) K.E. is maximum when x is maximum

Q.6 The frequency of the fundamental mode of open at one end organ pipe is 400 Hz. If one end of pipe is closed the fundamental frequency will be

A) 800 Hz
B) 400 Hz
C) 600 Hz
D) 200 Hz

Q.7 If two waves having same frequency and traveling in the same direction, the phenomenon is known as

A) Beats
B) Stationary waves
C) Interference
D) Diffraction

Q.8 A sonometer wire 100 cm in length has a fundamental frequency of 330 Hz. The velocity of propagation of waves along the wire is

A) 115 m/sec
B) 660 m/sec
C) 330 m/sec
D) 990 m/sec

Q.9 A sound source is moving towards stationary listener with 1/10th of the speed of sound. The ratio of apparent to real frequency is

A) 9:10
B) 10:9
C) 11:10
D) 10:11

Q.10 A narrow diameter tube X is held with its lower end immersed in water. The level of the water is adjusted for maximum sound while a vibrating tuning fork is held over the tube, then the length of the tube above the water is Y and the length of the tube in the water is Z.

If fundamental frequencies only are involved, the wavelength of the sound in the air will be approximately

A) 2 Y
B) 2 Z
C) 4 Y
D) 4 Z

Q.11 The fundamental frequency of a sound source is 256 Hz, Frequency of its first harmonic is

A) 128 Hz
B) 256 Hz
C) 512 Hz
D) 64 Hz

Q.12 During destructive interference of two waves of same amplitude, the CRO shows the

A) maximum displacement
B) zero displacement
C) double of original displacement
D) half of the original displacement

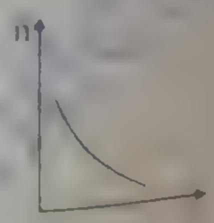
Q.13 The ratio of the separation between two consecutive nodes to the separation between two consecutive antinodes is

A) 1 : 2
B) 1 : 1
C) 2 : 1
D) 3 : 1

Q.14 A source of sound is travelling towards a stationary observer. The frequency of sound heard by the observer is of three times the original frequency. The velocity of sound is v m/sec. The speed of source will be

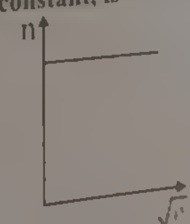
A) $\frac{2}{3}v$
B) v
C) $\frac{3}{2}v$
D) 3v

Q.15 The correct graph between the frequency (n) and square root of density ($\sqrt{\rho}$) of a wire, keeping its length, radius and tension constant, is

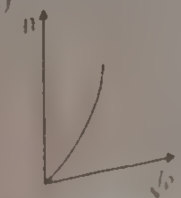


A)

B)



C)



D)

Q.16 In [illegible] wave, distance between a node and its nearest antinode is 20 cm. The phase difference between two particles having a separation of 60 cm will be

A) [illegible]
C) $3\pi/2$
B) zero
D) π

Q.17 Stationary waves of frequency 300 Hz are formed in a medium in which the velocity of sound is 1200 metre/sec. The distance between a node and the neighbouring antinode is

A) 2 m
C) 3 m
B) 1 m
D) 4 m

Q.18 A closed pipe and an open pipe have their first overtones identical in frequency. Their lengths are in the ratio

A) 1 : 2
C) 3 : 4
B) 4 : 5
D) 2 : 3

Q.19 An air column in a pipe, which is closed at one end, will be in resonance with a vibrating body of frequency 166 Hz, if the length of the air column is

A) 1.00 m
C) 0.50 m
B) 1.50 m
D) 2.00 m

Q.20 If the velocity of sound in air is 336 m/s. The maximum length of a closed pipe that would produce a just audible sound will be

A) 3.2 cm
C) 4.2 m
B) 3.2 m
D) 4.2 cm

Q.21 The fundamental frequency of stationary wave is

A) $f = \frac{1}{2l}\sqrt{\frac{F}{f}}$
C) $f = \frac{v}{l}$
B) $f = \frac{1}{2l}\sqrt{\frac{F}{m}}$
D) $f = \frac{1}{2vl}$

Q.22 The frequency of fundamental tone in an open organ pipe of length 0.48 m is 320 Hz. Speed of sound is 320 m/sec. Frequency of fundamental tone in closed organ pipe will be

A) 153.8 Hz
C) 160.0 Hz
B) 320.0 Hz
D) 1143.2 Hz

Q.23 If tension in a string is made four times, then speed of wave becomes

A) double
C) four times
B) one times
D) none

Q.24 Fundamental frequency of pipe is 100 Hz and other two frequencies are 300 Hz and 500 Hz then

A) pipe is open at both the ends
C) pipe is closed at both the ends
B) one end open and another end is closed
D) none of the above

Q.25 Length of a string tied to two rigid supports is 40 cm. Maximum length (wavelength in cm) of a stationary wave produced on it, is

A) 20
C) 10
B) 80
D) 40

Q.26 The waves which require a medium for their propagation are called

A) matter waves
C) electromagnetic waves
B) mechanical waves
D) complex waves

Q.27 Ripples produce in water is an example of

A) progressive waves
C) electromagnetic waves
B) light waves
D) electronic waves

The primary requirement for the generation of a wave is the presence of
A) receiver
[illegible] object
C) [illegible]
D) all of these

Transverse waves are those in which particles of the medium are displaced in a direction.
[illegible] to direction of propagation
[illegible] of propagation
C) perpendicular to direction of propagation
D) none to direction of propagation

The linear distance between two nearest points of a medium vibrating in phase is
[illegible]
[illegible]length
C) time period
D) frequency

Q.31 A particle executing S.H.M of period 4s. Then time taken by it to move from mean position to half the amplitude is
A) $\frac{1}{3}$ [illegible]
B) $\frac{1}{[illegible]}$ sec
C) $\frac{2}{3}$ sec
D) 4 sec

Q.32 **In order to double the period of simple pendulum:**
A) Length should be double
B) Mass should be quadrupled
C) Mass should be doubled
D) Length should be quadrupled

Q.33 A body performing simple harmonic motion has a displacement x given by the equation $x = 30 \sin 50t$, where time in seconds. What is the frequency of oscillation?
A) 0.020 Hz
B) 0.13 Hz
C) 8.0 Hz
D) 30 Hz

Q.34 Time taken by a S.H.M of time period 'T' to move from the mean position to the half of amplitude is
A) $\frac{T}{4}$
B) $\frac{T}{8}$
C) $\frac{T}{12}$
D) $\frac{T}{6}$

Q.35 A spring of force constant 'K' is cut into two pieces, such that one piece has double the length of the other. The shorter piece will have a force constant:
A) $\frac{2}{3K}$
B) $\frac{3K}{2}$
C) 3K
D) 2K

Q.36 Time period of mass spring system executing S.H.M depends upon:
A) Mass of system
B) Force constant
C) Amplitude
D) Both A) and B)

Q.37 The acceleration of a projection on the diameter for a particle moving along a circle is
A) $\omega^2 x$
B) ωx^2
C) ωx
D) ω [illegible]

Q.38 What should be the length of simple pendulum whose period is 6.28 second at a place where $g = 9.8\ m/s^2$
A) 9.8 m
B) [illegible]
C) 6.25 m
D) 10 m

Q.39 The force responsible for the vibratory motion of the simple pendulum is (where θ is angle of string with vertical)

A) mg $\cos\theta$ C) mg $\sin\theta$

B) mg $\tan\theta$ D) mg

Q.40 The maximum value of displacement in SHM is called

A) frequency C) amplitude

B) wavelength D) time period

Q.41 A body perform SHM, with period 0.063s the maximum speed is 3m/s. What are values of amplitude and angular frequency (rad/second) is;

A) $x_o = 0.03\text{m}, \omega = 100$ C) $x_o = 0.19, \omega = 16$

B) $x_o = 3.3\text{m}, \omega = 100$ D) $x_o = 5.3\text{m}, \omega = 16$

Q.42 What is the period of mass spring system in SHM if the ratio of mass to spring constant is $\frac{1}{4}$

A) π C) 2π

B) 4π D) $\frac{1}{\pi}$

Q.43 The maximum velocity of vibrating mass spring system is equal to

A) $x_o\sqrt{\frac{m}{k}}$ C) $\sqrt{\frac{x_o k}{m}}$

B) $x_o\sqrt{\frac{k}{m}}$ D) $\sqrt{\frac{x_o m}{k}}$

Q.44 **In a SHM, the energy of the system**

A) Is independent of the amplitude C) Is directly proportional to the amplitude

B) Is inversely proportional to the amplitude D) Is proportional to the amplitude squared

Q.45 **A particle executing S.H.M. while passing through the mean position, has:**

A) Maximum K.E and maximum P.E C) Maximum K.E and zero P.E

B) Minimum K.E and maximum P.E D) Zero K.E and maximum P.E

Q.46 **The product of the angular frequency and linear frequency of simple pendulum is:**

A) 2π C) $2\pi f^2$

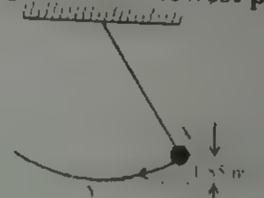
B) $\frac{1}{2\pi}$ D) $1/2\pi f^2$

Q.47 **The phase difference between $\vec{v}$ and $\vec{a}$ of simple harmonic oscillator is**

A) 40° C) 90°

B) 45° D) 180°

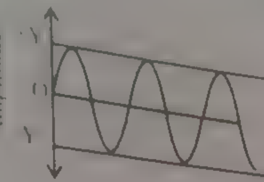
Q.48 **A simple pendulum consists of a 2.0 kg mass attachment to a string. It is released from rest at X as shown. Its speed at the lowest point Y is about:**



A) $0.90\ \text{ms}^{-1}$ C) $\sqrt{3.6}\ \text{ms}^{-1}$

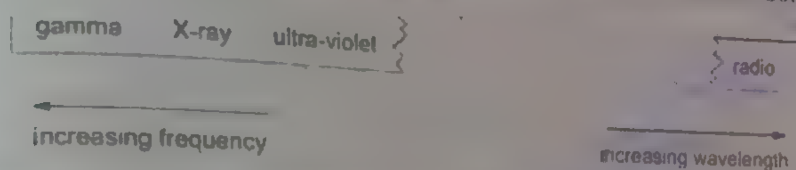
B) $3.6\ \text{ms}^{-1}$ D) $6.0\ \text{ms}^{-1}$

Q.49 Variation of amplitude w.r.t time for an oscillating object is shown in the fig. The graph shows ________ oscillation.

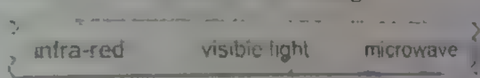


A) Damped
B) Un-damped
C) Critical
D) Heavily damped

Q.50 A wall poster showing the electromagnetic spectrum is displayed in a laboratory.

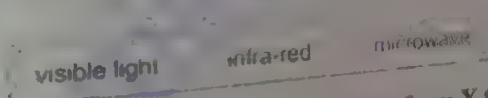


A section of the electromagnetic spectrum has been accidentally ripped from this wall poster. Which piece is missing?

A)


B)

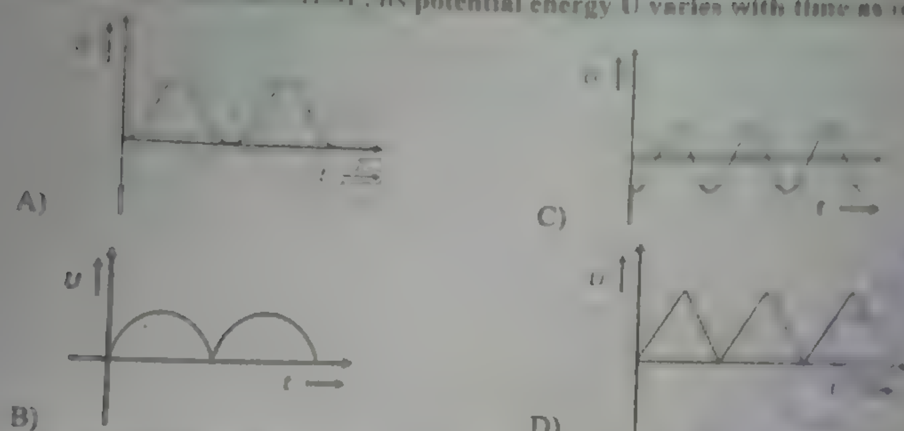

C)


D)


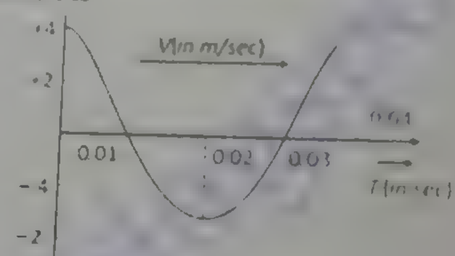
Q.51 The time taken for a pendulum to swing from X to Y is 1.5, then its frequency is

A) $\frac{1}{1.5}$ Hz
B) $\frac{1}{6}$ Hz
C) $\frac{1}{3}$ Hz
D) $\frac{1}{4}$ Hz

Q.52 As a body performs S.H.M., its potential energy U varies with time as indicated in

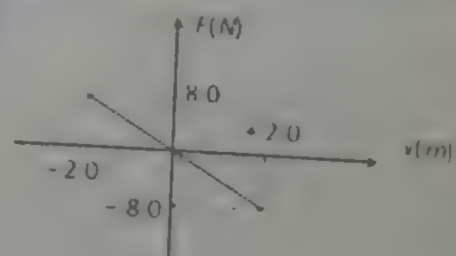


Q.53 The velocity-time diagram of a harmonic oscillator is shown in the adjoining figure. The frequency of oscillation is



A) 50 Hz
B) 25 Hz
C) 33.3 Hz
D) 25.5 Hz

Q.54 A body of mass 0.01 kg executes simple harmonic motion (S.H.M.) about x = 0 under the influence of a force shown below. The period of the S.H.M. is



A) 0.52 s
B) 0.30 s
C) 0.25 s
D) 1.05 s

Q.55 It is required to double the frequency of simple harmonic oscillator. It can be done by changing the suspended mass to

A) [illegible] of initial mass
B) [illegible]
C) $\frac{1}{4}$ of initial mass
D) [illegible]

The distance between two consecutive crests in a wave train produced in a string is 5 cm. If 2 complete waves pass through any point per second, the velocity of the wave is

A) 10 cm/sec
B) [illegible]
C) 2.5 cm/sec
D) 15 cm/sec

Q.57 **The wave length of light in visible part (λ_v) and for sound (λ_s) are related as**

A) $\lambda_v > \lambda_s$
B) $\lambda_s = \lambda_v$
C) $\lambda_s > \lambda_v$
D) None of these

Q.58 **The waves in which the particles of the medium vibrate in a direction perpendicular to the direction of wave motion is known as**

A) Transverse wave
B) Propagated waves
C) Longitudinal waves
D) None of these

Q.59 **It is possible to hear beats from the two vibrating sources of frequency**

A) 100 Hz and 150 Hz
B) 400 Hz and 500 Hz
C) 20 Hz and 25 Hz
D) 1000 Hz and 1500 Hz

Q.60 **If the tension of sonometer's wire increases four times then the fundamental frequency of the wire will increase by**

A) 2 times
B) 1/2 times
C) 4 times
D) None of the above

ANSWER KEY

1	C	11	B	21	B	31	A	41	A	51	B
2	D	12	B	22	C	32	D	42	A	52	A
3	A	13	B	23	A	33	C	43	B	53	B
4	C	14	A	24	B	34	C	44	D	54	B
5	C	15	A	25	B	35	C	45	C	55	C
6	B	16	C	26	A	36	D	46	C	56	A
7	C	17	B	27	C	37	A	47	C	57	C
8	B	18	C	28	C	38	A	48	D	58	A
9	B	19	C	29	B	39	C	49	B	59	C
10	C	20	C	30	[illegible]	40	C	50	D	60	A

5 UNIT LIGHT HEAT & THERMODYNAMICS

SELF ASSESSMENT TEST

Q.1 By Huygen's wave theory of light, we cannot explain the phenomenon of

A) Interference
C) Diffraction
B) Photoelectric effect
D) Polarisation

Q.2 Two identical light sources S_1 and S_2 emit light of same wavelength λ. These light rays will exhibit interference if

A) Their phase differences remain constant
C) Their phases are distributed randomly
B) Their light intensities remain constant
D) Their light intensities change randomly

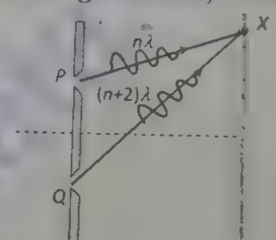
Q.3 For constructive interference to take place between two monochromatic light waves of wavelength λ, the path difference should be

A) $(2n-1)\frac{\lambda}{4}$
C) $(2n-1)\frac{\lambda}{2}$
B) $n\lambda$
D) $(2n+1)\frac{\lambda}{2}$

Q.4 In Young's double slit experiment, if the slit widths are in the ratio 1 : 9, then the ratio of the intensity at minima to that at maxima will be

A) 1
C) 1/9
B) 1/4
D) 1/3

Q.5 The figure shows a double slit experiment P and Q are the slits. The path lengths PX and QX are $n\lambda$ and $(n+2)\lambda$ respectively, where n is a whole number and λ is the wavelength. Taking the central fringe as zero, what is formed at X



A) First bright
C) First dark
B) Second bright
D) Second dark

Q.6 A line normal to the wavefront, showing the direction of propagation of light is called

A) Beam of light
C) Ray of light
B) Both "A" and "C"
D) None of these

Q.7 For 1 mole of gas the relation $P\Delta V=$

A) $R\Delta T$
C) $R\Delta V$
B) $R\Delta P$
D) $P\Delta T$

Q.8 When $\theta = 0$, along the direction of normal to the grating, the path difference between the rays coming out from the slits of grating will be

A) minimum
B) zero
C) maximum
D) none of these

Two monochromatic waves of the same wavelength are traveling through a medium. They can interfere destructively, provided their path difference is:

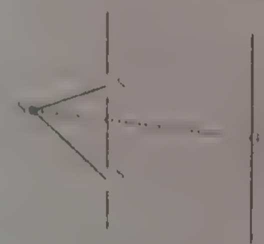
A) [illegible]

B) [illegible]

C) 2λ

D) 5λ

In the set up shown in Fig. The two slits S_1 and S_2 are not equidistant from the source S. The central fringe at O is then.



A) always bright

B) always dark

C) Neither dark or bright depending on the position of S

D) Neither dark nor bright

11 **Monochromatic light of wavelength λ is incident normally on a diffraction grating with the grating element d. At which angle with the normal to the grating is 2nd order diffracted beam observed?**

A) $\sin^{-1}\dfrac{2\lambda}{d}$

B) $\sin^{-1}\dfrac{\lambda}{2d}$

C) $\sin^{-1}\dfrac{d}{\lambda}$

D) $\sin^{-1}\dfrac{2d}{\lambda}$

12 **In YDSE if one of the slits is covered up with cellophane paper then**

A) Bright fringes become more bright while dark become more dark

B) Bright fringes become dark and dark become bright

C) Bright fringes become less bright and dark become less dark

D) No interference will take place

13 **To get order of the spectra using diffraction grating, we use the relation**

A) $n = \dfrac{\sin\theta}{\lambda}$

B) $n = \dfrac{\sin\theta}{d\lambda}$

C) $n = \dfrac{\sin\theta}{2\lambda}$

D) $n = \dfrac{d\sin\theta}{\lambda}$

14 **The fringe spacing depends upon**

A) Wavelength of light

B) Distance of screen from the slit

C) Separation between the slits

D) All of these

15 **If two torches are used in place of monochromatic light in young's experiment what will happen?**

A) fringe will occur as from monochromatic source

B) no fringes will appear

C) fringe will appear for a moment and then it will disappear

D) only bright fringe

Q.16 Two identical light sources S_1 and S_2 emit lights of same wavelength. These light rays will exhibit interference if

A) [illegible]
C) their light intensities remain constant
B) their phase differences remain constant
D) their phases are distributed randomly

Q.17 In an interference pattern with white light as source in YDSE

A) bright fringes are wider than dark fringes
B) central fringe is white
C) central fringe is bright
D) central fringes are dimmer than the outer fringes

Q.18 If the distance between a point source and screen is doubled, then intensity of light on the screen will become

A) half
C) double
B) one-fourth
D) four times

Q.19 When a two-slits arrangement was set up to produce interference fringes on a screen using a monochromatic source of green light, the fringes were found to be too close together for convenient observation. In which of the following ways would it be possible to increase the separation of the fringes?

A) decrease the distance between the screen and the slits
B) increase the distance between the source and the screen
C) have larger distance between the two slits
D) replace the light source with a monochromatic source of blue light

Q.20 For which color is the fringe width minimum?

A) Violet
C) Green
B) Red
D) Yellow

Q.21 What will be the distance between two slits which when illuminated by light of wavelength 5000Å, produce fringes of width 0.5 mm on a screen at distance 1 meter from the slits?

A) 10^{-2} meter
C) 10^{-4} meter
B) 10^{-3} meter
D) 10^{-6} meter

Q.22 Which of the following is formula for diffraction grating?

A) $d \sin\theta = \frac{n}{\lambda}$
B) $\sin\theta = \frac{n\lambda}{d}$
C) $\sin\theta = \frac{d}{n\lambda}$
D) $nd \sin\theta = \lambda$

Q.23 If distance of second bright fringe from centre is 2.2 nm and distance of third bright fringe from centre is 3.4 nm. The fringe width

A) 2.2 nm
C) 1.2 nm
B) 3.4 nm
D) 2.1 nm

Q.24 The value of sin θ for maximum order of spectra using a diffraction grating

A) 90
C) 1
B) 0
D) 45

Q.25 The ratio of phase difference and path difference is:

A) 2λ
B) $\frac{2\pi}{\lambda}$
C) $\frac{\lambda}{2\pi}$
D) $\frac{\pi}{\lambda}$

Q.26 In Young's double slit experiment, the position of dark fringes is given by

A) [illegible]
C) $Y_m = \frac{m\lambda d}{L}$
B) [illegible]
D) [illegible]

Q.27 Every point of a wave front may be considered as a source of secondary spherical wavelets, which spread out in forward direction with speed equal to speed of propagation of wave, its is known as:

A) Interference of light
B) 1st part of Huygens's principle
C) 2nd part of Huygens's principle
D) Diffraction of waves

Q.28 In the Young's double slit experiment, the spacing between two slits is 0.1 mm. If the screen is kept at a distance of 1.0 m from the slits and the wavelength of light is 5000 Å, then the fringe width is:

A) 1.0 cm
B) 0.5 cm
C) 1.5 cm
D) 2.0 cm

Q.29 The collection of rays is called ______

A) Beam
B) Wave front
C) Rays
D) Wave

Q.30 Two slits, 4 mm apart, are illuminated by light of wavelength 6000 Å. What will be the fringe width on a screen placed 2m from the slits

A) 0.12 mm
B) 0.3 mm
C) 3.0 mm
D) 4.0 mm

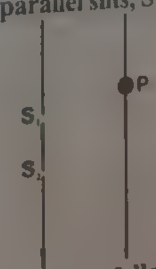
Q.31 The molecules of an ideal gas at thermodynamics (absolute) temperature T have a root-mean-square speed c_{rms}. The gas is heated to temperature 2T. What is the new root-mean-square speed of the molecules?

A) $\sqrt{2}\,c_{rms}$
B) $2\,c_{rms}$
C) $2\sqrt{2}\,c_{rms}$
D) $4\,c_{rms}$

Q.32 The average K.E of hydrogen molecules at 300 K is 'E'. At same temperature K.E of oxygen molecules will be:

A) $\frac{E}{16}$
B) E
C) $\frac{E}{4}$
D) $4E$

Q.33 Coherent light incident on two fine parallel slits, S_1 and S_2 as shown the diagram



If a dark fringe occurs at P, which of the following gives possible phase differences for the light wave arriving at P from S_1 and S_2?

A) $2\pi, 4\pi, 6\pi\ldots\ldots$
B) $\pi, 2\pi, 3\pi\ldots.$
C) $\pi, 3\pi, 5\pi\ldots\ldots$
D) $\frac{1}{2}\pi, \frac{5}{2}\pi, \frac{9}{2}\pi\ldots\ldots$

Q.34 Temperature of an ideal gas is increased from 120 K to 480 K. If at 120 K rms speed is 'v' then at 480k , it will:

A) [illegible]
B) 4 v
C) $\frac{v}{2}$
D) $\frac{v}{4}$

Q.35 The Young's double slits experiment is performed with blue and green light of wavelengths 4360 Å and 5460 Å, respectively. If x is the distance of fourth maximum from the central one, then

A) x (blue) = x (green)

B) x (blue) < x (green)

C) x (blue) > x (green)

D) x (blue) / x (green) = 5460 / 4360

Q.36 In Young's double slit experiment, the 10^{th} maxima of wavelength λ_1 is at the distance of y_1 from its central maxima and the 5^{th} maxima of wavelength λ_2 is at the distance of y_2 from its central maxima. The ratio $y_1 : y_2$ will be

A) $\frac{2\lambda_1}{\lambda_2}$

B) $\frac{\lambda_1}{2\lambda_2}$

C) $\frac{2\lambda_2}{\lambda_1}$

D) $\frac{\lambda_2}{2\lambda_1}$

Q.37 Angle between ray of light and wave front is:

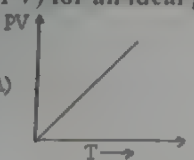
A) 0

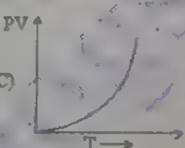
B) 45°

C) 60°

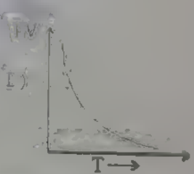
D) 90°

Q.38 Which one of the following graphs best illustrates the relationship between the product (PV) for an ideal gas and thermodynamics temperature?

A)


C)


B)


D)


Q.39 In case of point source, the shape of wave-front is

A) plane

B) cylindrical

C) spherical

D) circular

Q.40 Nine particles have speed of 5, 8, 12, 12, 12, 14, 14, 14, 17 ms^{-1}. What is average speed.

A) 10 m/s

B) 12 m/s

C) 15 m/s

D) 8 m/s

Q.41 The rms velocity of hydrogen and oxygen molecule's having ratio.

A) 1 : 4

B) 4 : 1

C) 1 : 2

D) 1 : 16

Q.42 Which of the following is expression of mean square speed of 'N' gas molecules contained in a cylinder

A) $\frac{v_1 + v_2 + \_\_\_\_\_ + v_N}{N}$

B) $\frac{v_1^2 + v_2^2 + \_\_\_\_\_ + v_N^2}{N}$

C) $\sqrt{\frac{v_1 + v_2 + \_\_\_\_\_ + v_N}{N}}$

D) $\sqrt{\frac{v_1^2 + v_2^2 + \_\_\_\_\_ + v_N}{N}}$

... shows that ... What is also true?

B) $\Delta U_p > \Delta U_v$

C) Both "A" and "B"

D) ΔU_p ... ΔU_v

A given amount of gas at 20° C has a pressure P. What will be temperature at 2P (volume remain constant).

A) 310°C

B) 315°C

C) 313°C

D) 308°C

R.M.S velocity of a molecule is C at pressure P. If pressure is increased two times, then R.M.S velocity becomes

A) 0.5 C

B) 2 C

C) C

D) 3 C

The force on the walls of a vessel contained gas is due to

A) the repulsive force between gas molecules

B) a slight loss in the speed of a gas molecule during a collision with the wall

C) elastic collisions between gas molecules

D) rate of change of momentum of a gas molecule during a collision with the wall

Q.47 Correct expression for pressure of a gas acting on wall of a container is

A) $P=\frac{Nm\langle v\rangle}{3l^3}$

C) $P=\frac{Nm\langle v\rangle^2}{3l^3}$

B) $P=\frac{3l^2\langle v\rangle^2}{Nm}$

D) $P=\frac{m\langle v\rangle^2}{3l^2}$

Q.48 A box contain x molecules of a gas. How will the pressure of the gas be affected if the number of molecules is made $2x$?

A) Pressure will decrease

B) Pressure will be doubled

C) Pressure will remain unchanged

D) Pressure will become three times

Q.49 If $\langle v_x^2\rangle = 3m^2s^{-2}$ then average square velocity of gas

A) $3\ m^2\ s^{-2}$

B) $6\ m^2\ s^{-2}$

C) $9\ m^2\ s^{-2}$

D) $\sqrt{3}$ ms

Q.50 An ideal gas is placed in a $4L$ container at a temperature of $300K$ and a pressure of 6 atmospheres. The pressure is held constant while the volume of the gas is halved. What is the new temperature of the gas?

A) 1200K

B) 300K

C) 600K

D) 150K

Q.51 A sample of oxygen and a sample of hydrogen have the same mass, volume and pressure. The ratio of their absolute temperature is

A) 1/4

B) 1/16

C) 4

D) 16

Q.52 Which one is true for internal energy?

A) it is sum of all forms of molecular energies of a system

B) it is proportional to transnational K.E of the molecules

C) it is a state function of a system

D) all are correct

Q.53 A gas is at one atmosphere. To what pressure it should be subjected at constant temperature so as to have $\frac{1}{4}$th of its initial volume?

A) 2 atmosphere
B) 3 atmosphere
C) 4 atmosphere
D) $\frac{1}{4}$ atmosphere

Q.54 The internal energy of a piece of lead when beaten by hummer will

A) decreases
B) remains same
C) increases
D) first increase and then decrease

Q.55 A fixed mass of gas at constant pressure occupies a volume V. The gas undergoes a rise in temperature so that the root-mean-square velocity of its molecules is doubled. What is the new volume?

A) 2V
B) 3V
C) 4V
D) 5V

Q.56 According to Charles' law,

A) At constant pressure, volume of a gas is proportional to its absolute temperature
B) At constant pressure, the volume of a gas is not proportional to its absolute temperature
C) At constant gauge pressure, the molecular volume of a gas is proportional to its absolute temperature
D) At constant volume, the absolute pressure is proportional to absolute temperature

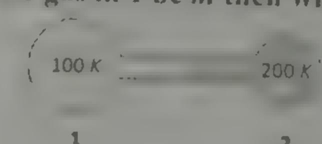
Q.57 A perfect gas at 27°C is heated at constant pressure so as to triple its volume. The temperature of the gas will be

A) 81°C
B) 627°C
C) 900°C
D) 450°C

Q.58 The temperature of 2 mole of a gas is changed. From 100°C to 120°C at constant volume. The change in internal energy was found to be 80 J. What is the molar heat capacity of this gas at constant volume?

A) 0.4 J K^{-1} mol^{-1}
B) 4 J K^{-1} mol^{-1}
C) 2.0 J K^{-1} mol^{-1}
D) 8 J K^{-1} mol^{-1}

Q.59 Figure shows two flasks connected to each other. The volume of the flask 1 is twice that of flask 2. The system is filled with an ideal gas at temperature 100 *K* and 200 *K* respectively. If the mass of the gas in 1 be *m* then what is the mass of the gas in flask



A) *m*
B) $\frac{m}{4}$
C) $\frac{m}{2}$
D) $\frac{m}{8}$

Q.60 If 1 mole of an ideal gas is heated at constant pressure then

A) [illegible]
B) [illegible]
C) [illegible]
D) [illegible]

ANSWER KEY

1	B	11	A	21	B	31	A	41	B	51	D
2	A	12	C	22	B	32	B	42	B	52	D
3	B	13	D	23	C	33	C	43	D	53	C
4	B	14	D	24	C	34	A	44	C	54	C
5	B	15	B	25	B	35	B	45	C	55	C
6	C	16	B	26	B	36	A	46	D	56	A
7	A	17	B	27	B	37	D	47	C	57	B
8	B	18	B	28	B	38	A	48	B	58	C
9	B	19	B	29	A	39	C	49	C	59	B
10	C	20	A	30	B	40	B	50	D	60	C

UNIT 6 ELECTROSTATICS

SELF ASSESSMENT TEST

Q.1 **A charge q_1 exerts some force on a second charge q_2. If third charge q_3 is brought near, the force of q_1 exerted on q_2**

A) Decreases
B) Remains unchanged
C) Increases
D) Increases if q_3 is of the same sign as q_1 and decreases if q_3 is of opposite sign

Q.2 **F_g and F_e represents gravitational and electrostatic force respectively between electrons situated at a distance 10 *cm*. The ratio of F_g/F_e is of the order of**

A) 10^{42}
B) 1
C) 10
D) 10^{-43}

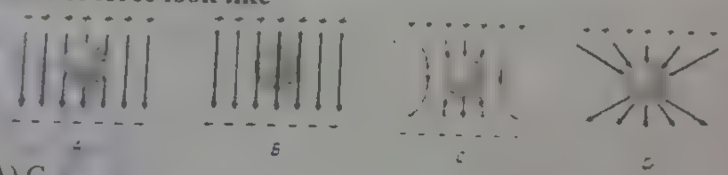
Q.3 **If a unit positive charge is taken from one point to another over an equipotential surface, then**

A) Work is done on the charge
B) Work done is constant
C) Work is done by the charge
D) No work is done

Q.4 **An electron enters in an electric field with its velocity in the direction of the electric lines of force. Then**

A) The path of the electron will be a circle
B) The velocity of the electron will decrease
C) The path of the electron will be a parabola
D) The velocity of the electron will increase

Q.5 **An uncharged sphere of metal is placed in between two charged plates as shown. The lines of force look like**



A) C
B) D
C) A
D) B

Q.6 **The potential difference between head and tail of an "electric eel" can be upto.**

A) 6 V
B) 6000 V
C) 60 V
D) 600 V

Q.7 **Two point charges repel each other with a force of 4×10^{-5} newton at a distance of meter. Two charges are**

A) Both positive
B) Both negative
C) Alike
D) Unlike

Q.8 **The energy stored in a unit volume of the dielectric between parallel plate of a capacitor is**

A) Energy density $= \frac{1}{2}E^2\varepsilon_o\varepsilon_r$
B) Energy density $= \frac{E^2}{2\varepsilon_o\varepsilon_r}$
C) Energy density $= \frac{E^2\varepsilon_o}{2\varepsilon_r}$
D) Energy density $= \frac{1}{2}\varepsilon_o\varepsilon_r E$

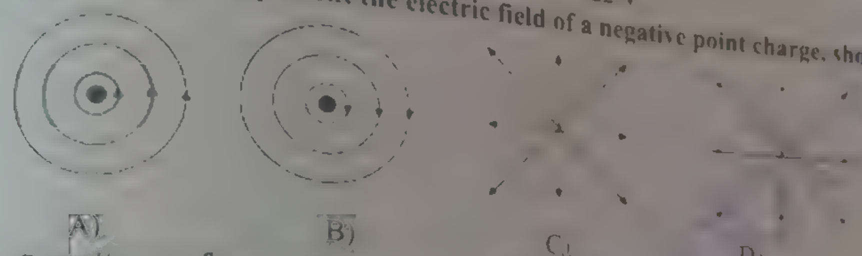
Q.9 The large horizontal metal plates are separated by 4 mm. The lower plate is at a potential of −6 V.

What potential should be applied to the upper plate to create an electric field of strength 4000 Vm−1 upward in the space between the plates?

A) +22 V　　　C) −10 V

B) +10 V　　　D) −22 V

Q.10 Which diagram represent the electric field of a negative point charge, shown by



A)　　B)　　C)　　D)

Q.11 Capacitance of a capacitor does not depend upon

A) Separation between plates　　　C) Thickness of the plates

B) Area of the plates　　　D) Medium between the plates

Q.12 A metallic solid sphere is placed in a uniform electric field. Which of given path of electric field line is correct.

A) A　　　C) B

B) C　　　D) D

Q.13 A charge of 2C experiences a force 2000 N in a uniform electric field. In this field the potential difference between two points separated by a distance 1cm is

A) 2 V　　　C) 10 V

B) 5 V　　　D) 20 V

Q.14 An α-particle is accelerated through potential difference 2000volt. Its K.E will be

A) 2000eV　　　C) 40000eV

B) 4000eV　　　D) 20000eV

Q.15 Which of given is not the unit of electric intensity

A) NC^{-1}　　　C) NV^{-1}

B) Vm^{-1}　　　D) None of these

Q.16 The electrons separated by a distance 'r' experience a force F between them. The force between a proton and a singly ionized helium atom separated by a distance 2r is:

A) $4F$　　　C) $2F$

B) $\frac{F}{2}$　　　D) $\frac{F}{4}$

Q.17 Static charges creates

A) electric field　　　C) magnetic field

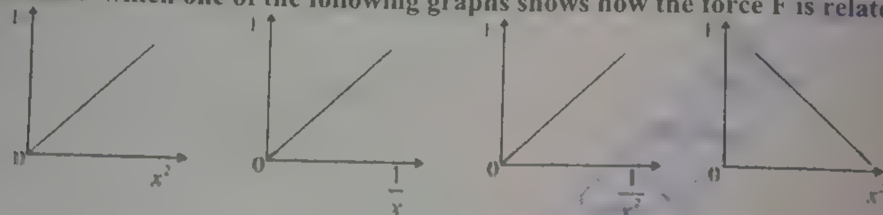
B) both a and b　　　D) gravitational field

Q.18 Electric field lines are originated from
A) negative charges
B) positive charges
C) both of A & B
D) none of these

Q.19 Capacitance with air is 10F, if a dielectric of $\varepsilon_r = 100$ is inserted then new capacitance
A) 1000 F
B) 1000 F
C) 10 nF
D) 100 F

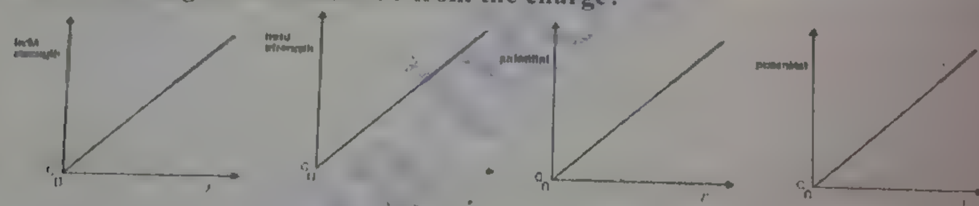
Q.20 The electrostatic force between two point charges q_1 and q_2 at separation r is given by $F = kq_1 q_2 / r^2$ The constant k
A) Depends on the system of units only
B) Depends on the medium between the charges only
C) Depends on both the system of units and the medium between the charges
D) Is independent of both the system of units and the medium between the charges

Q.21 A point charge at a distance x from another point charge experiences a force of repulsion F which one of the following graphs shows how the force F is related to x?



A) B) C) D)

Q.22 Which graph correctly relates the electric field strength or electric potential in the field of a point charge, with distance r from the charge?



A) B) C) D)

Q.23 How many electrons will have a charge of two coulomb?
A) 6.2×10^{18}
B) 6.2×10^{19}
C) 12.5×10^{18}
D) 5.2×10^{19}

Q.24 The capacity of a parallel plate capacitor is $5\mu F$. When a glass plate is placed between the plates of the capacitor, its potential becomes 1/8 of the original value. The value of dielectric constant will be
A) 1.6
B) 5
C) 8
D) 40

Q.25 In central region of a parallel plate capacitor the electric field lines are
A) perpendicular
B) orthogonal
C) parallel
D) curved

Q.26 In a charged capacitor the energy resides in
A) Electric field surrounding the capacity
B) Electric field inside the capacitor
C) Both "A" and "B"
D) Gravitational field

Value of ε_r for various dielectrics is always
A) Less than unity
B) Equal to unity
C) Larger than unity
D) No hard and fast rule

If the distance between the two-point charges become half, then force between them becomes ________
A) Double
B) Half
C) Four times
D) Remains same

Q.29 If $F = \frac{kq_1q_2}{r^2}$ then $\frac{F}{q_1}$ is
A) The force on q_1
B) Electric field generated by q_2
C) [illegible]
D) [illegible]

Q.30 The electric force between two charges placed in air is 2 N. When placed in a medium of ε 80, the force reduces
A) 0.019 N
B) 0.029 N
C) [illegible] N
D) [illegible] N

Q.31 If the distance between the two-point charges become one-fourth, then force between them becomes ________
A) Double
B) Four times
C) Half
D) Sixteen times

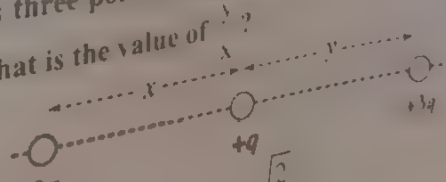
Q.32 An isolated charged point particle produces an electric field with magnitude E at a point 2 m away. At a point 1m from the particle the magnitude of the field is
A) 2 E
B) 3 E
C) 4 E
D) E

Q.33 An ECG records ________ between points on human skin
A) voltage
B) electric flux
C) [illegible]
D) all of these

Q.34 An electric charge at rest produces ________
A) Only a magnetic field
B) Neither electric field nor magnetic field
C) Only an electric field
D) Both electric and magnetic fields

Q.35 A gold nucleus (radius r) is represented by the symbol [illegible]. Taking e as the elementary charge and ε_o as the permittivity of free space, what is the electric field strength at the surface of an isolated gold nucleus?
A) Zero
B) $\frac{79e}{4\pi\varepsilon_o r^2}$
C) $\frac{197e}{4\pi\varepsilon_o r^2}$
D) [illegible]

Q.36 The figure below shows three point charges, all positive. If the net electric force on the center charge is zero, what is the value of $\frac{y}{x}$?

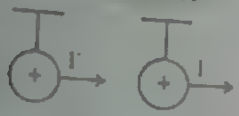


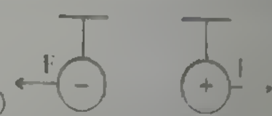
A) $\frac{4}{9}$
C) $\sqrt{\frac{2}{3}}$
D) $\frac{3}{2}$
B) $\sqrt{3}$

Q.37 The quantity $\frac{1}{2}\varepsilon_o E^2$ has the significance of:

A) Energy farad
B) Energy volume
C) Energy coulomb
D) Energy

Q.38 Which diagram correctly show the force F that act on two charged spheres suspended close to each other

A) 

C) 

B) 

D) 

Q.39 Two electric charges originally 4 cm apart are brought closer to each other until the force between them becomes of 4 times. How much they separated now?

A) 1 cm
B) 0.5 cm
C) 2 cm
D) 0.25 cm

Q.40 A proton (mass = 1.67×10^{-27} kg) on entering in a vertical electric field E is balanced. Then the electric field strength is

A) 10^{-9} Vm^{-1}
B) 10^{-7} Vm^{-1}
C) 10^{+7} Vm^{-1}
D) 10^{-8} Vm^{-1}

Q.41 An external agency carries '–5 C' of charge from infinity to a point in an electrostatic field and performs 100 joule of work. The potential at the given point is

A) 10 V
B) 20 V
C) –10 V
D) –20 V

Q.42 A tin nucleus has charge + 50e. If the proton is at a distance 10^{-12} m from the nucleus, then the potential V at this position is [charge on the proton = 1.6×10^{-19}C]

A) 14.4×10^{4} volt
B) 7.2×10^{8} volt
C) 7.2×10^{4} volt
D) 14.4×10^{8} volt

Q.43 A Capacitor which has a capacitance of 1 farad will

A) Be fully charged in 1 second by a current of 1 ampere
B) Store 1 coulomb of charge at a potential difference of 1 volt
C) Gain 1 joule of energy when 1 coulomb of charge is stored on it
D) Discharge in 1 second when connected across a resistor of resistance 1 ohm

Q.44 A point charge A of charge +4 μC and another point charge B of charge –1 μC are placed in air at a distance 1 metre apart. Then the distance of the point on the line joining the charges A and from the charge B, where the resultant electric field is zero, is (in metre)

A) 1.5
B) 1
C) 0.5
D) 2

The ratio of the forces between two small conducting spheres charged to constant potentials in (a) air (b) a medium of K = 2 is

C) 1:2

D) 4:1

Four charges 2C, –3C, –4C and 5C respectively are placed at all the corners of a square. Which of the following statements is true for the point of intersection of the diagonals?

A) Electric field is zero but electric potential is non-zero

B) Electric field non-zero but electric potential is zero

C) Both electric field and electric potential is zero

D) Neither electric field nor electric potential are zero

Q.47 The distance between the plates of a parallel plate condenser is 4 mm and potential difference is 60 volt. If the distance between the plates is increased to 12 mm, then

A) the potential difference will remain unchanged

B) the potential difference will become 20 volt

C) the potential difference of the condenser will become 180 volt

D) the charge on condenser will reduce to one-third

Q.48 The capacity of a condenser in which a dielectric of dielectric constant 5 has been used, is C. If the dielectric is replaced by another with dielectric constant 20, the capacity will become

A) $\frac{C}{4}$

C) 4C

B) $\frac{C}{2}$

D) 2C

Q.49 A capacitor of capacitance C is charged to a potential V. The flux of the electric field through a closed surface enclosing the capacitor is

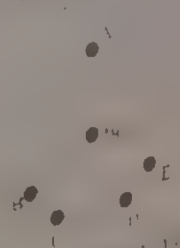
A) zero

C) $\frac{CV}{\varepsilon_0}$

B) $\frac{2CV}{\varepsilon_0}$

D) $\frac{CV}{2\varepsilon_0}$

Q.50 In the electric field of a point charge q, a certain charge is carried from point A to B, C, D and E. Then the work done.



A) Is least along path AB

B) Is least along path AD

C) Is least along path AE

D) Is zero along all the paths

Q.51 The variation of potential with distance r from a fixed point is as shown below. The electric field at $r = 5$ m is

[illegible]

Q.52 The electric field strength at a distance r from the center of a charged sphere of radius R is E. If r [illegible] R, how much work will be done in bringing a test charge q_o from infinity to that point?

A) q_oRE

B) $\frac{1}{2}q_oRE$

C) q_orE

D) $\frac{1}{2}q_orE$

Q.53 Dielectric constant of pure water is 81. Its permittivity will be:

A) 7.17×10^{-10} MKS units

B) 8.86×10^{-12} MKS units

C) 1.2×10^{-13} MKS units

D) Cannot be calculated

Q.54 The capacity of a parallel plate condenser is $5\mu F$. When a glass plate is placed between the plates of the conductor, its potential becomes 1/8 of the original value. The value of dielectric constant will be

A) 1.6

B) 5

C) 8

D) 40

Q.55 The capacity of a condenser is 4×10^{-6} farad and its potential is 100*volts*. The energy released on discharging it fully will be

A) 0.02 Joule

B) 0.04 Joule

C) 0.025 Joule

D) 0.05 Joule

Q.56 Can a metal be used as a medium for dielectric?

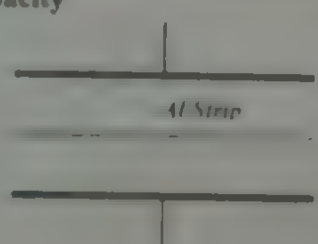
A) Yes

B) No

C) Depends on its shape

D) Depends on dielectric

Q.57 As shown in the figure, a very thin sheet of aluminium is placed in between the plates of the condenser. Then the capacity



[illegible]

[illegible] between the plates of a parallel plate capacitor is d. A metal plate of thickness of 2 [illegible] placed between the plates. The capacitance would then be

A) [illegible]

B) [illegible]

C) Zero

D) Doubled

Force of attraction between the plates of a parallel plate capacitor is

A) [illegible]

B) [illegible]

C) $\frac{q}{\epsilon_0 AK}$

D) $\frac{q^2}{2\epsilon_0 A K}$

Between the plates of a parallel plate condenser there is 1mm thick paper of dielectric constant 4. It is charged at 100 volt. The electric field in volt/metre between the plates of the capacitor is

A) 100

B) 25000

C) 100000

D) 4000000

ANSWER KEY

1	B	11	C	21	C	31	D	41	D	51	B
[illegible]	D	12	D	[illegible]	D	32	C	42	C	52	C
[illegible]	D	[illegible]	C	[illegible]	C	33	A	43	B	53	A
[illegible]	B	[illegible]	B	[illegible]	C	34	C	44	B	54	C
[illegible]	A	[illegible]	C	[illegible]	C	[illegible]	B	45	C	55	A
[illegible]	D	[illegible]	D	[illegible]	B	[illegible]	B	[illegible]	B	56	B
[illegible]	C	[illegible]	A	[illegible]	C	37	B	47	C	57	C
[illegible]	A	[illegible]	B	[illegible]	C	[illegible]	B	48	C	58	D
[illegible]	D	[illegible]	B	[illegible]	B	[illegible]	C	[illegible]	A	59	A
10	D	[illegible]	C	[illegible]	C	[illegible]	B	[illegible]	D	60	C

7 UNIT
CURRENT ELECTRICITY
SELF ASSESSMENT TEST

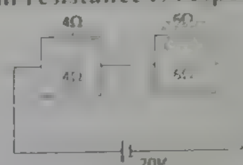
Q.1 The temperature coefficient of resistance for a wire is $0.00125\ {}^\circ C^{-1}$. At 300K its resistance is 1 ohm. The temperature at which the resistance becomes 2 ohm is

A) 1154 K
B) 1400 K
C) 1100 K
D) 1127 K

Q.2 Calculate the amount of charge flowing in 2 minutes in a wire of resistance 10 Ω when a potential difference of 20 V is applied between its ends

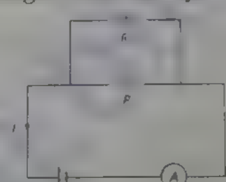
A) 120 C
B) 20 C
C) 240 C
D) 4 C

Q.3 Four resistances are connected in a circuit in the given figure. The electric current flowing through 4 ohm and 6 ohm resistance is respectively



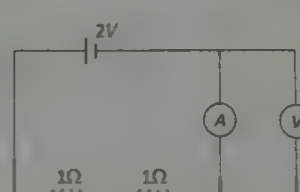
A) 2 amp and 4 amp
B) 1 amp and 1 amp
C) 1 amp and 2 amp
D) 2 amp and 2 amp

Q.4 If a resistance R_2 is connected in parallel with the resistance R in the circuit shown, then possible value of current through R and the possible value of R_2 will be



A) $\frac{I}{3}$, R
B) $\frac{I}{3}$, 2R
C) I, 2R
D) $\frac{I}{2}$, R

Q.5 In the circuit shown, A and V are ideal ammeter and voltmeter respectively. Reading of the voltmeter will be



A) 2 V
B) 0.5 V
C) 1 V
D) Zero

Q.6 A wire has a resistance 12 ohm. It is bent in the form of a circle. The effective resistance between the two points on any diameter of circle is

A) 12 Ω
B) 6 Ω
C) 24 Ω
D) 3 Ω

The smallest resistance obtained by connecting 50 resistances of 1.4 ohm each is

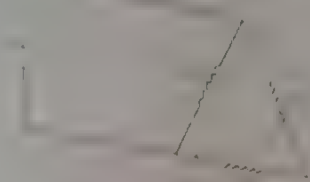
[illegible] Ω

[illegible] Ω

C) [illegible] Ω

D) [illegible] Ω

The current 'I' in the figure below is



A) 1/5 A

B) 1/10 A

C) 1/15 A

D) 1.45 A

Two resistances R_1 and R_2 ($R_1 < R_2$) are connected in parallel. Which of the following is true for equivalent resistance R?

A) $R < R_1$

B) [illegible]

C) [illegible]

D) [illegible]

Three 2 Ω resistor are arranged in a triangle. What is the resistance between any two corners?

A) 4 Ω

B) 3 Ω

C) 4/3 Ω

D) 3/4 Ω

11 Two unequal resistances are connected parallel across a battery. Which of the following statement is true?

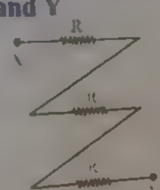
A) Same current will flow through both resistances

B) Current through smaller resistance is higher

C) Current through larger resistance is higher

D) Current can be higher in any resistance depending on emf of the cell

12 Three resistances each having value 'R' are connected as shown in figure what is the equivalent resistance between X and Y



A) R

B) 3R

C) $\frac{R}{3}$

D) R^3

13 When a wire is stretched double of is length, then its resistance will be

A) 16 R

B) 2 R

C) 4 R

D) 8 R

14 Graph between V and I for non-ohmic devices

A) Straight line

B) Usually not straight line

C) Always not straight line

D) Sometime straight line

An electrical bulb marked 100 W, 200 V would mean the resistance is

A) 200 ohm

B) 400 ohm

C) 50 ohm

D) [illegible] ohm

The current in a resistor is 8.0 mA. What charge flows through the resistor in 0.020 s?

[illegible]

B) 1.6 mC

C) [illegible] mC

D) [illegible] mC

Q.17 Which equation is used to define resistance?

A) [illegible]

B) [illegible]e = current × resistance

C) [illegible] resistance

D) [illegible]y = resistance × area ÷ length

Q.18 In the circuit shown, a potential difference of 3 V is applied across XY.

What is the current through the 5 Ω resistor?

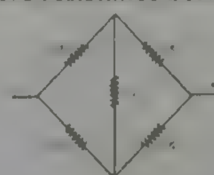
A) $\frac{15}{[illegible]}$ A

C) $\frac{3}{5}$ A

B) $\frac{3}{4}$ A

D) $\frac{3}{8}$ A

Q.19 In the given network, the effective resistance between the points A and B is



A) 25 Ω

C) 20 Ω

B) 10 Ω

D) 30 Ω

Q.20 Which of the following statements is not true?

A) Conductance is the reciprocal of resistance and is measured in siemens

B) Ohm's law is not applicable at very low and very high temperatures

C) Ohm's law is applicable to semiconductors

D) Ohm's law is not applicable to electron tubes, discharge tubes

Q.21 Ohm's law establishes a relation between

A) Current and voltage

C) Resistance and voltage

B) Charge and voltage

D) Current and resistance

Q.22 When 2 Ohm, 4 Ohm and 6 Ohm resistance are connected in parallel, their resultant resistance will be

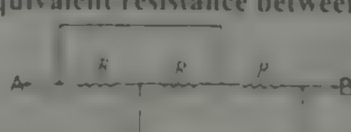
A) 12 Ohm

C) $\frac{11}{12}$ Ohm

B) $\frac{12}{11}$ Ohm

D) Data is insufficient

Q.23 In the given network the equivalent resistance between A and B is



A) R

C) 3R

B) [illegible]

D) $\frac{2R}{3}$

Which of the following statements applies to a thermistor?

Its resistance fall when more light fall on it

Its resistance rise when its temperature increases.

... when more light fall on it

... drop when its temperature increases

A 100 W, 200V bulb is connected to a 160 V supply. The actual power consumption would be

A) 64 W

B) 72 W

C) 100 W

D) 90 W

26 Electrical energy is converted to heat at the rate of ________.

A) IRt

B) I^2R

C) I^2Rt

D) VIt

27 A 40 W lamp turns half the electrical energy to give light. How much light energy does it give out in 10 s?

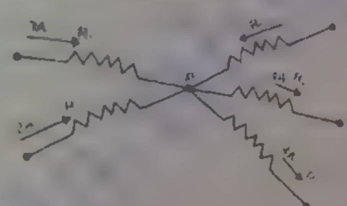
A) 200 J

B) 400 J

C) 800 J

D) 40 J

28 Consider the circuit diagram in which a mesh is shown carrying currents in each resistor. What is the current passing through "R_5"?



A) 10

B) 6 A

C) 3 A

D) 2 A

29 Which of the following have the same temperature coefficient of resistivity?

A) iron and silver

B) iron and platinum

C) platinum and silver

D) silver and gold

30 A battery lights all five bulbs as in figure. Which bulb, if removed, would cause all the lamps to go out?

C) Pink only

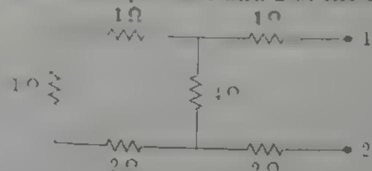
D) Yellow only

A) Red only

Q.31 For an ohmic conductor, doubling the voltage without changing the resistance will cause the current to

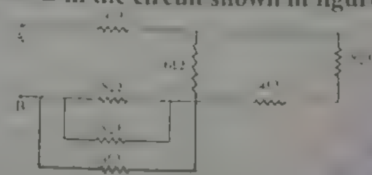
A) Increase by a factor of 4
B) Remain unchanged
C) Decrease by a factor of 2
D) Increase by a factor of 2

Q.32 The equivalent resistance between points 1 and 2 of the circuit shown is:



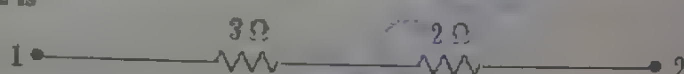
A) 5 Ω
B) 6 Ω
C) 10 Ω
D) 3 Ω

Q.33 Resistance between points A and B in the circuit shown in figure is



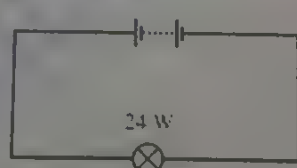
A) 4 Ω
B) 10 Ω
C) 6 Ω
D) 8 Ω

Q.34 In the diagram, the current in the 3-Ω resistor is 4 A. The potential difference between points 1 and 2 is



A) 20 V
B) 12 V
C) 0.8 V
D) 1.25 V

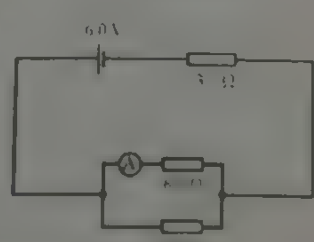
Q.35 A battery is used to light a 24 W electric lamp. The battery provides a charge of 120 C in 60 s.



What is the potential difference across the bulb?

A) 5 V
B) 24 V
C) 12 V
D) 120 V

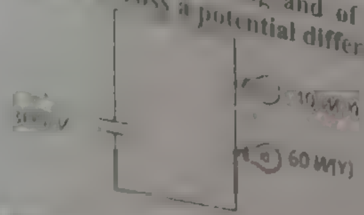
Q.36 The following circuit is set up.



What is the reading on the ammeter?

A) 0.33 A
B) 0.67 A
C) 0.50 A
D) 1.0 A

Two bulbs X and Y having same voltage rating and of power 40 watt and 60 watt respectively are connected in series across a potential difference of 300 volt, then

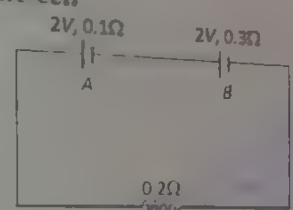


A) X will glow brighter
B) heat produced in Y will be greater than X
C) resistance of Y is greater than X
D) voltage drop in X will be greater than Y

The terminal potential difference of a cell when short-circuited is (E = E.M.F. of the cell)

A) E
B) Zero
C) E/2
D) E/3

The internal resistances of two cells shown are 0.1Ω and 0.3Ω. If $R = 0.2\Omega$, the potential difference across the cell



A) B will be zero
B) A and B will be 2V
C) A will be zero
D) A will be > 2V and B will be < 2V

40. A typical value of drift velocity is

A) $1\ mm\ s^{-1}$
B) $10\ ms^{-1}$
C) $1\ ms^{-1}$
D) $1000\ km\ s^{-1}$

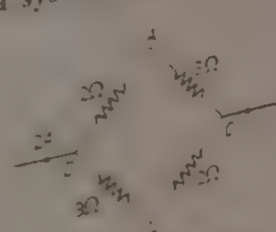
41. There are 8 equal resistances R. Two are connected in parallel, such four groups are connected in series, the total resistance of the system will be

A) R / 2
B) 2 R
C) 4 R
D) 8 R

42. Three resistances of one ohm each are connected in parallel. Such connection is again connected with $2/3\ \Omega$ resistor in series. The resultant resistance will be

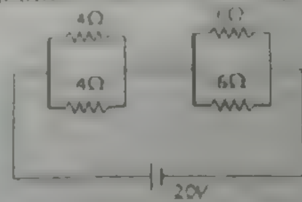
A) $\frac{5}{3}\Omega$
B) $\frac{3}{5}\Omega$
C) 1Ω
D) $\frac{2}{3}\Omega$

A current of 2 A flows in a system of conductors as shown. The potential difference $(V_A - V_B)$ will be



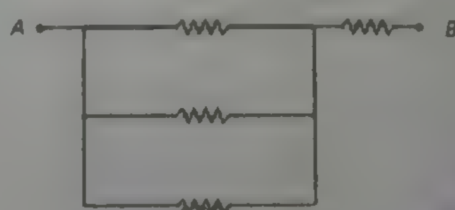
A) +2V
C) 1V
D) 2V

Q.44 **Four resistances are connected in a circuit in the given figure. The electric current flowing through 4 ohm and 6 ohm resistance is respectively**



A) 2 amp and 4 amp
B) 1 amp and 2 amp
C) 1 amp and 1 amp
D) 2 amp and 2 amp

Q.45 **If all the resistors shown have the value 2 ohm each, the equivalent resistance over AB is**

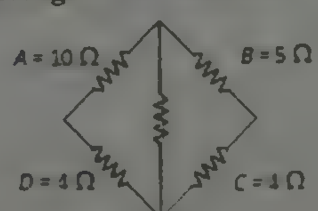


A) 2 ohm
B) 6 ohm
C) $2\frac{2}{3}$ ohm
D) $\frac{2}{3}$ ohm

Q.46 Two resistance wires on joining in parallel the resultant resistance is 6/5 *ohms*. One of the wire breaks, the effective resistance is 2 ohms. The resistance of the broken wire is

A) $\frac{3}{5}$ ohm
B) 2 ohm
C) $\frac{6}{5}$ ohm
D) 3 ohm

Q.47 In a typical Wheatstone network, the resistances in cyclic order are A = 10 Ω, B = 5 Ω, C = 4 Ω and D = 4 Ω for the bridge to be balanced



A) 10 Ω should be connected in parallel with A
B) 10 Ω should be connected in series with A
C) 5 Ω should be connected in series with B
D) 5 Ω should be connected in parallel with B

Q.48 A wire 100cm long and 2.0 mm diameter has a resistance of 0.7 ohm, the electrical resistivity of the material is

A) 4.4×10^{-6} ohm × m
B) 2.2×10^{-6} ohm × m
C) 1.1×10^{-6} ohm × m
D) 0.22×10^{-6} ohm × m

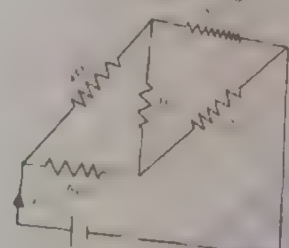
Q.49 The resistance of a conductor is 5 ohm at 50 °C and 6 ohm at 100 °C. Its resistance at 0 °C is

A) 1 ohm
B) 2 ohm
C) 3 ohm
D) 4 ohm

Q.50 A new flashlight cell of emf 1.5 volts gives a current of 15 A, when connected directly to an ammeter of resistance 0.04 Ω. The internal resistance of cell is

A) 0.04 Ω
B) 0.06 Ω
C) 0.10 Ω
D) 10 Ω

Q.51 For the network shown the value of the current i is



A) $\frac{18V}{5}$
B) $\frac{5V}{9}$
C) $\frac{9V}{35}$
D) $\frac{5V}{18}$

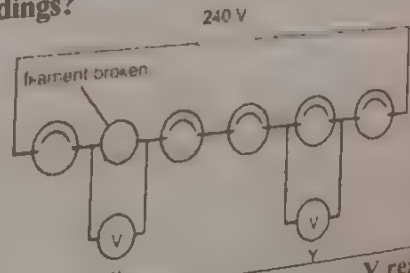
Q.52 A heater coil is cut into two equal parts and only one part is now used in the heater. The heat generated will now be

A) halved
B) one-fourth
C) four times
D) doubled

Q.53 A copper wire is stretched to make it 0.1 % longer. The percentage increase in resistance will be

A) 0.2
B) 2
C) 1
D) 0.1

Q.54 A mains circuit contains six similar bulbs connected in series. One of the bulbs has a broken filament. Voltmeters X and Y of infinite resistance are placed in the circuit as shown. What are voltmeter readings?

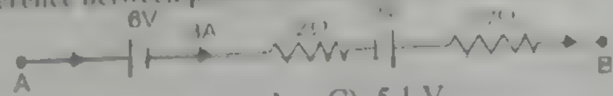


	X reading	Y reading
A)	0 V	0 V
B)	0 V	240 V
C)	40 V	40 V
D)	240 V	0 V

Q.55 What is the number of equal parts into which a conductor having a resistance R = [illegible] Ω should be cut to obtain the resistance R = [illegible] Ω if the parts are connected in parallel?

A) 5
B) 10
C) 20
D) ?

Q.56 The potential difference between points A and B in the circuit is



A) 3 V
B) 15 V
C) -5.1 V
D) +5.1 V

Q.57 A 2 Ω and a 2 3 Ω resistors are connected in parallel across a 3 V battery. The energy given out per minute is

A) 60×2×3 J
B) 60×9/2×3×3 J
C) 60×1/2×3×3 J
D) 60×3×3×2 J

Q.58 If the current in electric bulb decreases by 0.5%, then the power in the bulb decreases by approximately

A) 1%
B) 2%
C) 0.5%
D) 0.25%

Q.59 The resistance of a wire of uniform diameter d and length l is R. The resistance of another wire of the same material but diameter 2d and length $4l$ will be

A) 2R
B) R
C) $\frac{R}{2}$
D) $\frac{R}{2}$

Q.60 In case of potentiometer the ratio of e.m.f's is equal to the ratio of balanced

A) Mass
B) Length
C) Time
D) Current

ANSWER KEY

1	C	11	B	21	A	31	D	41	B	51	D
2	C	12	B	22	B	32	A	42	C	52	D
3	D	13	C	23	B	33	B	43	B	53	A
4	D	14	C	24	D	34	A	44	D	54	D
5	D	15	B	25	A	35	C	45	C	55	B
6	D	16	A	26	C	36	C	46	D	56	D
7	B	17	B	27	A	37	A	47	A	57	D
8	B	18	D	28	C	38	B	48	B	58	A
9	A	19	B	29	B	39	A	49	D	59	B
10	C	20	C	30	A	40	A	50	B	60	B

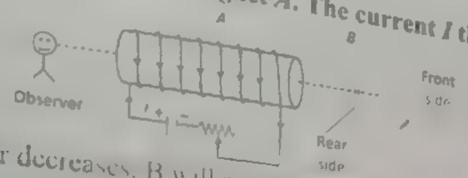
ELECTROMAGNETISM AND ELECTROMAGNETIC INDUCTION

SELF ASSESSMENT TEST

Q.1 In a circuit with a coil of resistance 2 ohms, the magnetic flux changes from 2.0 Wb to 10.0 Wb in 0.2 second. The charge that flows in the coil during this time is

A) 5.0 coulomb
B) 1.0 coulomb
C) 4.0 coulomb
D) 0.8 coulomb

Q.2 **An aluminium ring *B* faces an electromagnet *A*. The current *I* through *A* can be altered**



A) Whether I increases or decreases, B will not experience any force
B) If I increases, A will attract B
C) If I decrease, A will repel B
D) If I increases, A will repel B

Q.3 **The ratio of secondary to the primary turns in a transformer is 3 : 2. If the power output be *P*, then the input power neglecting all loses must be equal to**

A) 5 P
B) P
C) 1.5 P
D) $\frac{2}{5}$P

Q.4 **The efficiency of transformer is very high because**

A) There is no moving part in a transformer
C) It produces very high voltage
B) It produces very low voltage
D) None of the above

Q.5 **A step-down transformer is used on a 1000 *V* line to deliver 20 *A* at 120 *V* at the secondary coil. If the efficiency of the transformer is 80% the current drawn from the line is .**

A) 3 A
B) 0.3 A
C) 30 A
D) 2.4 A

Q.6 **The force acting on a charge q moving with a velocity $\dot{v}$ in a magnetic field of induction $\dot{B}$ is given by:**

A) $q/(\dot{v} \times \dot{B})$
B) $(\dot{v} \times \dot{B})/q$
C) $q(\dot{V} \times \dot{B})$
D) $q(\dot{V} \cdot \dot{B})$

Q.7 **A 2 MeV proton is moving perpendicular to a uniform magnetic field of 2.5 T. The force on the proton is:**

A) 2.5×10^{10} N
B) [illegible]
C) 2.5×10^{11} N
D) [illegible] $\times 10^{12}$ N

Q.8 **A long straight current carrying conductor has current direction from bottom to top when held vertically. What will be the direction of magnetic field lines when observed from below the conductor?**

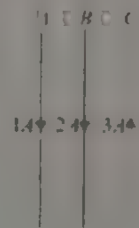
C) Anticlockwise
D) Vertically downward

Q.9 Two long straight wires are set parallel to each other at separation r and each carries a current I in the same direction. The strength of the magnetic field at any point midway between the two wires is

A) $\frac{\mu_o I}{r}$ C) $\frac{2\mu_o I}{2r}$

B) $\frac{2\mu_o I}{r}$ D) Zero

Q.10 Three infinite straight wires A, B and C carry currents as shown in fig, the resultant force on wire B is directed:



A) Towards A C) Zero

B) Towards C D) Perpendicular to the plane of the page

Q.11 Magnetic lines of force

A) Always intersect

B) Are always closed

C) Tend to crowd far away from the poles of a magnet

D) Do not pass through vacuum

Q.12 An electron of mass m is accelerated through a potential difference of V and then it enters a magnetic field of induction B normal to the lines. Then the radius of the circular path is

A) $\sqrt{\frac{2eV}{m}}$ C) $\sqrt{\frac{2Vm}{eB}}$

B) $\sqrt{\frac{2Vm}{eB^2}}$ D) $\sqrt{\frac{2Vm}{e^2B}}$

Q.13 The magnitude of the force on a moving charge is maximum when angle between the velocity of the charge and the magnetic field is,

A) 0° C) 90°

B) 180° D) 45°

Q.14 When the current flowing through the wire is stopped, the magnetic field around the wire becomes.

A) Doubles C) Remains same

B) Half D) Zero

Q.15 If a charge particle enters a uniform magnetic field there is a change in its

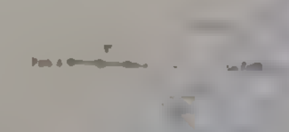
A) Kinetic energy C) Direction of velocity

B) Magnitude of velocity D) All of these

Q.16 PQRS is a square loop made of uniform conducting wire. If the current enters the loop at P and leaves at S, then the magnetic field will be:

A) Maximum at the centre of the loop
B) Zero at the centre of loop
C) Zero at all points inside the loop
D) Zero at all points outside of the loop

Q.17 **The fig shows a uniform magnetic field $\vec{B}$** directed into the plane of paper. A particle with negative charge moves in the plane. Which of four paths 1, 2, 3 or 4 does the particle follow



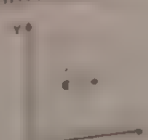
A) Path 1
B) Path 2
C) Path 3
D) Path 4

Q.18 **Which of the following Statements is false?**
A) A stationary charge produces a constant electric field
B) [illegible]
C) [illegible]
D) [illegible]

Q.19 Two current carrying conductors are placed parallel as shown in figure. Which point will experience the strong magnetic field?

C) Both experience same magnetic f
D) None of these

Q.20 In the given figure the electron enters into the magnetic field. It deflects in ___ direction



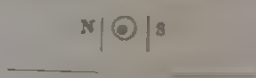
[illegible]

Q.21 In the formula $F = q\,v \times B$ [illegible]

[illegible] particle of charge $-4.0 \times 10^{-?}$ C and mass 2×10^{-4} kg is perpendicular to a [illegible] field. If the particle's speed is 3×10^{4} m/s, what is the acceleration of particle due to the magnetic force?

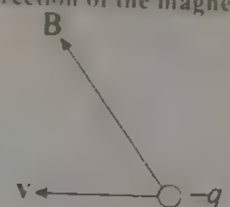
[illegible]
C) [illegible]
[illegible] m/s
D) 0.6 m/s^2

Q.23 [illegible] shows a straight wire carrying a flow of electrons into the page. The wire is between [illegible] of a permanent magnet. The direction of the magnetic force exerted on the wire is



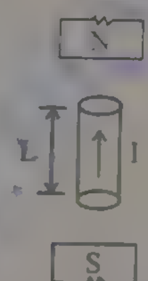
A) ↓
C) →
B) ←
D) ↑

Q.24 In the figure below, what is the direction of the magnetic force F_B?



A) [illegible]
C) Downward in the plane of the page
B) [illegible] the plane of the page
D) Out of the plane of the page

Q.25 A wire carrying current (I) is place in a region of magnetic field as shown in figure direction of force is



A) into paper
C) out of paper
B) towards right
D) no force is acting

Q.26 Which of the following cannot be deflected by a magnetic field?
A) Alpha rays
C) Gamma rays
B) Beta rays
D) Cosmic rays

Q.27 Electron and proton of equal momentum enter a uniform magnetic field normal to the lines of force. If the radii of curvature of circular paths be r_e and r_p respectively, then

A) $\frac{r_e}{r_p} = 1$
C) $\frac{r_e}{r_p} = \sqrt{\left(\frac{m_p}{m_e}\right)}$

B) $\frac{r_e}{r_p} = \frac{m_p}{m_e}$
D) $\frac{r_e}{r_p} = \sqrt{\left(\frac{m_e}{m_p}\right)}$

Q.28 A current flows in a conductor from east to west. The direction of the magnetic field at a points above the conductor is

A) towards south
B) towards east
C) towards north
D) towards west

Q.29 A rectangular loop carrying a current i is situated near a long straight wire such that the wire is parallel to the one of the sides of the loop and is in the plane of the loop. If a steady current I is established in wire as shown in figure, the loop will

A) remain stationary
B) move away from the wire or towards right
C) rotate about an axis parallel to the wire
D) move towards the wire

Q.30 3 A of current is flowing in a linear conductor having a length of 40 cm. The conductor is placed in a magnetic field of strength 500 gauss and makes an angle of 30° with the direction of the field. It experiences a force of magnitude

A) 3×10^{-4} newton
B) 3×10^{4} newton
C) 3×10^{-2} newton
D) 3×10^{2} newton

Q.31 A coil having an area 2 m^2 is placed in a magnetic field which changes from 1 Wb/m^2 to 4 Wb/m^2 in a interval of 2 second. The e.m.f. induced in the coil will be

A) 4 V
B) 3 V
C) 1.5 V
D) 2 V

Q.32 Which one of the following does not affect the magnitude of the induce emf in electromagnetic induction?

A) The strength of the magnetic field linkage the coil
B) The resistance of the coil cutting the magnetic field
C) The speed with which the coil cuts the magnetic field
D) The number of turns in the coil

Q.33 A step-up transformer

A) Increases power-level
B) Increases voltage-level
C) Decreases current-level
D) Both B and C

Q.34 The number of turns in the primary and secondary coil of a step up transformer are 200 and 500 respectively. If the power in the input is 100 Watt and current 1A then the output power and current will respectively

A) [illegible] W, 2 A
B) [illegible] W, 1 A
C) 200 W, 0.2 A
D) 100 W, 0.4 A

Q.35 An A.C generator produces alternating voltage with peak value of 220 V. The rms value of the alternating voltage is:

A) [illegible] C) [illegible] Volts

B) $\frac{[illegible]}{\sqrt{2}}$ Volts D) $\frac{220}{\sqrt{2}}$ Volts

Q.36 If the instantaneous current in a circuit is given by $I = 2\sin(\omega t + \theta)$ amperes, the rms value of the current is

A) $\sqrt{2}$ A C) $2\sqrt{2}$ A

B) 2 A D) zero

Q.37 In an ac circuit, peak value of voltage is 423 volts. Its effective voltage is

A) 400 volts C) 300 volts

B) 323 volts D) 340 volts

Q.38 The ratio of the secondary to the primary turns in a transformer is 3:2 and the output power is P. Neglecting all power losses, the input power must be

A) P/2 C) P

B) 2P/3 D) 3P/2

Q.39 In the step up transformer, when the alternating voltage increase then the alternating current will

A) Increase C) Not change

B) Decrease D) Not depend on core

Q.40 If the core of transformer is of substance whose hysteresis loop area is decreased then the efficiency of transformer is

A) increased C) decreased

B) same as original D) none of these is possible

Q.41 The primary and secondary coils of a transformer are linked

A) Electrically C) Magnetically

B) Chemically D) Are not linked at all

Q.42 If the secondary coil has N_s turns and the primary N_p turns, the relation between secondary and primary voltages is given by ________

A) $V_s/V_p = N_p/N_s$ C) $V_s/V_p = N_s/N_p$

B) $V_p/V_s = N_s/N_p$ D) $V_p/V_s = N_pN_s$

Q.43 Why does a transformer have a core made of iron

A) Iron has a high melting point C) Iron is a conductor of electricity

B) Iron is a conductor of heat D) Iron is a magnetic material

Q.44 A coil of wire is arranged with its plane perpendicular to a uniform magnetic field of flux density B. when the radius of the coil increases from r_1 to r_2 in time Δt, then what is the emf induced in the coil?

A) $\frac{\pi B\left(r_2^2 - r_1^2\right)}{\Delta t}$

B) $\frac{B\left(r_2^2 - r_1^2\right)}{\Delta t}$

C) $\frac{\pi B\left(r_2 - r_1\right)^2}{\Delta t}$

D) $\frac{\pi B\left(r_2^2 + r_1^2\right)}{\Delta t}$

Q.45 A step up transformer has transformation ratio of 3:2. What is the voltage in secondary if the primary voltage is 30 V?

A) 20 V
B) 45 V
C) 60 V
D) 15 V

Q.46 Eddy currents are produced in a material when it is

A) Heated
B) Placed in an electric field
C) Placed in a time varying magnetic field
D) Placed in a uniform magnetic field

Q.47 The coils of a step down transformer have 500 and 5000 turns. In the primary coil an AC of 4 A at 2200 volts in sent. The value of the current and potential difference in the secondary will be.

A) 20 A, 22 V
B) 40 A, 220 V
C) 0.4 A, 22000 A
D) 40 A, 22000V

Q.48 In a step up transformer the number of turns in

A) Primary are less
B) Primary and secondary are equal
C) Primary are more
D) Primary are infinite

Q.49 The alternating current has frequency of 10^6 Hz, in such a way that time period for completion of cycle is

A) $1\mu s$
B) 10^6sec
C) $1.5\mu s$
D) 1sec

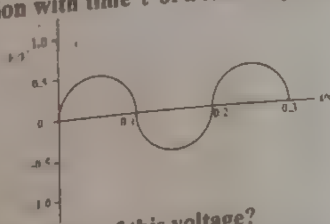
Q.50 Which of the following quantity remain same in the transformer?

A) Current
B) Voltage
C) Frequency
D) All of these

Q.51 For long distance transmission, the transformer used is

A) Step down
B) Step up
C) Input voltage and output voltage remain same
D) Amplifier is used

Q.52 The graph shows the variation with time t of a low-frequency alternating voltage V.



Which expression is a representation of this voltage?

A) $0.5\sin(0.4\pi t)$
B) $0.5\sin(10\pi t)$
C) $1.0\sin(0.2\pi t)$
D) $1.0\sin(10\pi t)$

Q.53 Emf induced in a circuit according to Faraday's law depends on the ______

A) Maximum magnetic flux
B) Change in magnetic flux
C) Rate of change of Electric flux
D) Time rate of change of magnetic flux

Q.54 An alternating current or voltage ____________
A) Fluctuates off and on
B) Changes its direction again and again
C) Varies in magnitude alone
D) Changes its magnitude continuously and reverses its direction of flow after regular recurring intervals.

Q.55 There is a sinusoidal alternating current in a resistor. What is the mean power dissipated in the resistor?
A) 0.5 (maximum current)^2
C) 0.5 (maximum power)
B) $\sqrt{2}$ (maximum power)
D) $\frac{1}{2}$ (maximum current)^2

Q.56 A transformer is also called
A) Static device
C) Dynamic device
B) Rotatory device
D) None of these

Q.57 A straight copper wire is moved in a uniform magnetic field such that it cuts the magnetic lines of force. Then
A) emf will not be induced
B) sometimes emf will be induced and sometimes not
C) emf will be induced
D) nothing can be predicted

Q.58 When a coil of cross-sectional area A and number of turns N is rotated in a uniform magnetic field B with angular velocity ω, then the maximum emf induced in the coil will be
A) BNA
C) $\frac{Ba2\pi f}{N}$
B) $\frac{BNA2\pi}{T}$
D) $\frac{BNA}{2\pi f}$

Q.59 If instantaneous current is given by $i = 4\cos(\omega t + \varphi)$ amperes, then the r.m.s. value of current is
A) 4 amperes
C) $2\sqrt{2}$ amperes
B) $4\sqrt{2}$ amperes
D) Zero amperes

Q.60 The voltage of domestic ac is 220 volt. What does this represent
A) Mean voltage
C) Peak voltage
B) Root mean voltage
D) Root mean square voltage

ANSWER KEY

1	C	11	B	21	B	31	B	41	C	51	B
2	D	12	B	22	B	32	B	42	C	52	B
3	B	13	C	23	D	33	D	43	D	53	D
4	A	14	D	24	D	34	D	44	A	54	D
5	A	15	C	25	D	35	C	45	B	55	C
6	C	16	B	26	C	36	A	46	C	56	A
7	D	17	C	27	A	37	C	47	B	57	C
8	A	18	D	28	C	38	C	48	A	58	B
9	D	19	A	29	D	39	B	49	A	59	C
10	A	20	D	30	C	40	A	50	C	60	D

9 UNIT

DEFORMATION OF SOLIDS AND ELECTRONICS

SELF ASSESSMENT TEST

Q.1 In a P-N junction diode if P region is heavily doped than n region then the depletion layer is

A) Greater in P region
B) Equal in both region
C) Greater in N region
D) No depletion layer is formed in this case

Q.2 In a wire of length L, the increase in its length is l. If the length is reduced to half, the increase in its length will be

A) l
B) $\frac{l}{2}$
C) $2l$
D) None of the above

Q.3 The force constant of a wire does not depend on

A) Nature of the material
B) Length of the wire
C) Radius of the wire
D) None of the above

Q.4 The pressure of a medium is changed from 1.01×10^5 Pa to 1.165×10^5 Pa and change in volume is 10% keeping temperature constant. The Bulk modulus of the medium is

A) 204.8×10^5 Pa
B) 51.2×10^5 Pa
C) 102.4×10^5 Pa
D) 1.55×10^5 Pa

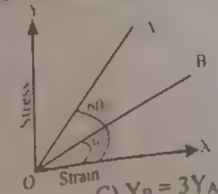
Q.5 If the work done in stretching a wire by 1 mm is 2 J, the work necessary for stretching another wire of the same material but double the radius and half the length by 1 mm is

A) 16 J
B) 4 J
C) 8 J
D) (1/4) J

Q.6 A copper wire and a steel wire of the same diameter and length are connected end to end and a force is applied which stretches their combined length by 1 cm. Then the two wires have

A) The same stress and strain
B) The same stress but different strains
C) The same strain but different stresses
D) Different stresses and strains

Q.7 The stress versus strain graphs for wires of two materials A and B are as shown in the figure. If Y_A and Y_B are the respective Young's modulii of the materials, then



A) $Y_B = 2Y_A$
B) $Y_A = 2Y_B$
C) $Y_B = 3Y_A$
D) $Y_A = 3Y_B$

Q.8 Which material has same value of Young's and Bulk modulus

A) [illegible]
B) [illegible]
C) Iron
D) Platinum

Q.9 If the tensile force is suddenly removed from a wire then its temperature will

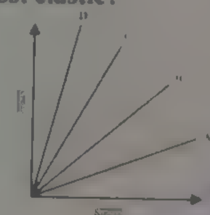
A) Decrease
B) Increase
C) Become zero
D) Remain constant

Q.10 The limit upto which the stress is directly proportional to strain is called
A) [redacted]
B) Proportional limit
C) [redacted]
D) Breaking limit

Q.11 **Energy per unit volume of stretched wire is**
A) $\left(\frac{1}{2}\right)$ × load × extension
B) Load × stress
C) Stress × strain
D) $\left(\frac{1}{2}\right)$ × stress × strain

Q.12 **For a ductile substance**
A) It has elastic as well as plastic regions
B) It does not break just after elastic limit
C) It only has elastic region and breaks after it
D) Both A and B

Q.13 **Which of the following solids is most elastic?**



A) A
B) B
C) C
D) D

Q.14 A cube of each of length 3 m is subjected to a normal force of 36 N. The stress on a cube is
A) 12 N m^{-2}
B) 4 N m^{-2}
C) 2 N m^{-2}
D) 8 N m^{-2}

Q.15 A rubber band of length l is pulled from both sides such that it extends up to l_1 in this condition the band is under
A) Tensile strain
B) Tensile stress
C) Shear stress
D) Shear strain

Q.16 The energy stored per unit volume of a strained wire is (Y is the Young's modulus of the material of the wire)
A) $\frac{1}{2}\times\text{load}\times\text{extension}$
B) $\frac{1}{2}\times Y\times\frac{Y}{(\text{Strain})^2}$
C) $\frac{1}{2}Y\times(\text{strain})^2$
D) Stress × strain

Q.17 An elongation of 0.1% in a wire of cross-sectional area 10^{-6} m^2 causes a tension of 100 N The young's modulus is
A) 10^{12} N/m^2
B) 10^{11} N/m^2
C) 10^{10} N/m^2
D) 10^{2} N /m^2

Q.18 The young's modulus of a wire of length L and radius r is Y. If the length is reduced to L/2 and radius to r/2, its young's modulus will be
A) Y/2
B) Y
C) 2 Y
D) 4 Y

Q.19 **An elastic wire when stretched by force F_1 its length is l_1. The energy stored in the wire during extension form l_1 to l_2 is**

A) [illegible] $+ F_2)(l_1 - l_2)$

B) $\frac{1}{2}$ [illegible]

C) $\frac{1}{2}$ [illegible]

D) $\frac{1}{2}$ [illegible]

Q.20 **When a force is applied at one end of an elastic wire, it produces a strain ε in the wire. If Y is the young's modulus of the material of the wire, the amount of energy stored per unit volume of the wire is given by**

A) $Y\varepsilon$

B) $Y\varepsilon^2$

C) ½ $Y\varepsilon$

D) ½ $Y\varepsilon^2$

Q.21 **A wire, suspended vertically from one end, is stretched by attaching a weight of 20 N to the lower end. The weight stretches the wire by 1 mm. How much energy is gained by the wire?**

A) 0.01 J

B) 0.04 J

C) 0.02 J

D) 1.0 J

Q.22 **How does the Young's modulus relate with the temperature?**

A) Inversely

B) Does not depend

C) Directly

D) None of these

Q.23 **Any alteration produced in shapes, length or volume when a body is subjected to some external force is called**

A) Stiffness

B) Extension

C) Toughness

D) Deformation

Q.24 **Young's modulus is a proportionality constant that relates the force per unit area applied perpendicularly at the surface of an object to:**

A) The shear

B) The fractional change in length

C) The fractional change in volume

D) The pressure

Q.25 **If "a" be original area, "Δa" be change in area and θ be deforming angle then shear strain can be defined as:**

A) Tanθ

B) Δa/a

C) θ (For small deformation)

D) All of above

Q.26 **The fractional change in length is called**

A) tensile strain

B) tensile stress

C) shear strain

D) shear stress

Q.27 **Longitudinal stress addresses to the:**

A) volume changes due to the applied stress

B) shape changes due to the applied stress

C) length changes due to the applied stress

D) length changes due to compressive strain

Q.28 **The value of Young's Modulus for water**

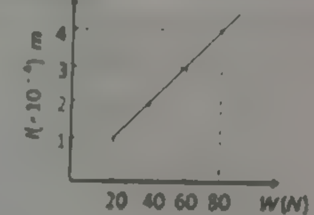
A) 80×10^9 N m^{-2}

B) 70×10^9 N m^{-2}

C) zero

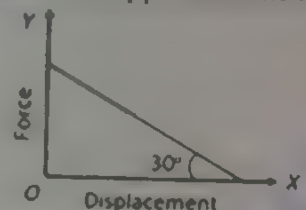
D) 2.2 × 10[illegible] N m

Q.29 The adjacent graph shows the extension (Δl) of a wire of length 1m suspended from the top of a roof at one end with a load W connected to the other end. If the cross sectional area of the wire is $10^{-6}\ m^2$, calculate the young's modulus of the material of the wire



A) $2\times10^{-11}\ N/m^2$
B) $3\times10^{-12}\ N/m^2$
C) $2\times10^{11}\ N/m^2$
D) $2\times10^{-13}\ N/m^2$

Q.30 The value of force constant between the applied elastic force F and displacement will be

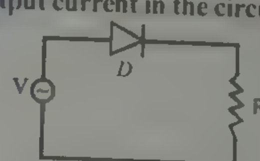


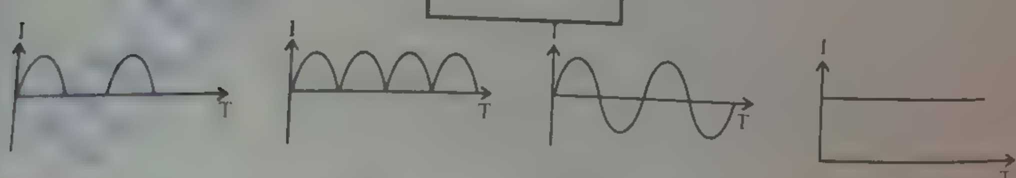
A) 1/3
B) $1/\sqrt{3}$
C) $\sqrt{3}/2$
D) 1/2

Q.31 In a full wave rectifier, the diode conducts during
A) Both halves of the input cycle
B) A portion of the positive half cycle of the input
C) Positive half cycle of the input
D) Negative half cycle or positive half cycle

Q.32 The method by which only one half of A.C cycle is converted into direct current is called
A) half wave amplification
B) half wave rectification.
C) full wave rectification
D) full wave amplification

Q.33 A PN junction (D) shown in the figure can act as a rectifier. An alternating current source (V) is connected in the circuit. The output current in the circuit is represented by:





A) B) C) D)

Q.34 In full wave rectification, the output D.C. voltage across the load is obtained for________
A) The positive half cycle of input A.C.
B) The negative half cycle of input A.C.
C) The complete cycle of input A.C
D) All of the above

Electrostatics, Current Electricity & Electronics

...rectification known as half wave rectification is obtained by

...voltage

...half wave of A.C supply by using diode

...C. cathode tube

The length of a wire increases by 1% on suspending a mass of 2 kg from it. What is ...strain in wire?

D) 0.001

Q.39 **The diodes works on**

A) A.C

B) D.C

C) both "A" and "B"

D) none of these

Q.40 **A forward biased diode is.**

A) 

B) 

C) 

D) 

In full wave rectification by bridge the number of diodes required are

A) 3

C) 5

In the process of rectification the current received across the load resistance is

A) A.C

D) both B and C

The ... of open loop gain of an operational amplifier is of the order of

...over laps

...conduction band

...valence band

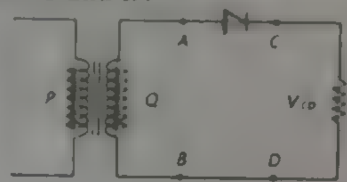
D) No band over laps

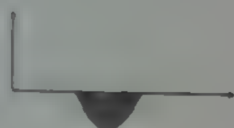
...of temperature

Q.46 Semiconductors with donor atoms and free electrons belong to the type ____

A) N
C) P
B) mix
D) any of above

Q.47 In the half-wave rectifier circuit shown. Which one of the following wave forms is true for VCD, the output across C and D?



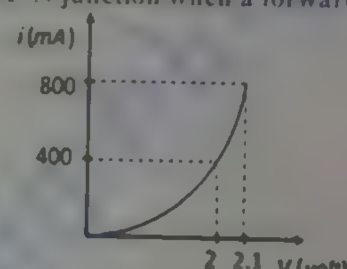
A) 

C) 

B) 

D) 

Q.48 The I-V characteristic of a P-N junction diode is shown below. The approximate dynamic resistance of the P-N junction when a forward bias of 2volt is applied



A) 0.25 Ω
C) 0.5 Ω
B) 5 Ω
D) 1 Ω

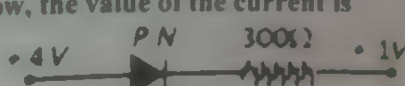
Q.49 PN-junction diode works as a insulator, if connected

A) in reverse bias
C) in forward bias
B) in forward bias and in reverse bias
D) none of these

Q.50 The reverse biasing in a PN junction diode

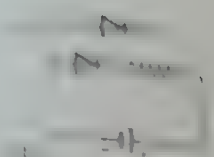
A) increases the potential barrier
B) decreases the potential barrier
C) increases the number of minority charge carriers
D) increases the number of majority charge carriers

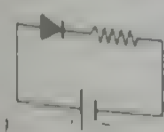
Q.51 In the circuit given below, the value of the current is



C) 10^{2} amp
A) 0
D) 10^{-3} amp
B) 10^{-2} amp

Q.52 [illegible] is in forward bias?





C)

D) none of these.

Q.53 If no external voltage is applied across P-N junction, there would be

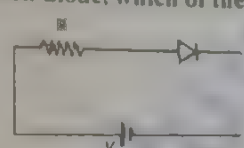
A) [illegible] electric field across the junction

B) an electric field pointing from P-type to N-type side across the junction

C) an electric field pointing from N-type to P type side across the junction

D) a temporary electric field during formation of P-N junction that would subsequently disappear

Q.54 **For the given circuit of PN-junction diode, which of the following statement is correct?**



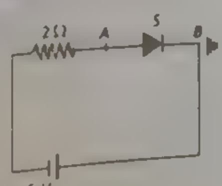
A) in forward biasing the voltage across R is 2 V

B) in reverse biasing the voltage across R is V

C) in forward biasing the voltage across R is V

D) in reverse biasing the voltage across R is 2 V

Q.55 The diode shown in the circuit is a silicon diode. The potential difference between the points A and B will be



A) [illegible] V

B) [illegible] V

C) 0.6 V

D) 6 V

Q.56 During negative half cycle of A.C then p-n junction offers

A) high resistance

B) [illegible] resistance

C) low resistance

D) all of these

Q.57 The number of inputs of Op-Amp are

A) [illegible]

B) [illegible]

C) 3

D) 4

Q.58 The resistance between (+) and (-) inputs in ideal case of operational amplifier

A) [illegible]

B) [illegible]

C) low

D) high

Q.59 A body is said to be in the state of stress when its atoms are ______ their equilibrium position

A) Rotate about
B) Displaced from
C) Vibrate around
D) Static at

Q.60 An energy band which is either empty or partially filled with electrons is named

A) Conduction band
B) Forbidden band
C) Valance band
D) Core band

ANSWER KEY

[illegible]	C	11	D	21	A	31	A	41	D	51	B
[illegible]	B	[illegible]	D	[illegible]	A	[illegible]	B	[illegible]	D	[illegible]	D
[illegible]	D	[illegible]	A	[illegible]	D	[illegible]	A	[illegible]	B	[illegible]	C
[illegible]	D	[illegible]	B	24	B	[illegible]	C	[illegible]	B	[illegible]	C
[illegible]	A	[illegible]	B	25	D	[illegible]	A	[illegible]	B	[illegible]	D
[illegible]	B	[illegible]	C	[illegible]	A	[illegible]	C	[illegible]	A	[illegible]	A
[illegible]	D	[illegible]	B	[illegible]	C	[illegible]	C	[illegible]	D	[illegible]	A
[illegible]	A	[illegible]	B	[illegible]	C	[illegible]	B	[illegible]	A	[illegible]	D
[illegible]	B	[illegible]	B	[illegible]	C	[illegible]	C	[illegible]	A	[illegible]	B
[illegible]	B	[illegible]	D	[illegible]	B	[illegible]	B	[illegible]	A	[illegible]	C

10 UNIT

MODERN PHYSICS

SELF ASSESSMENT TEST

Q.1 **When the kinetic energy of an electron is increased, the wavelength of the associated wave will**

A) Increase

B) Wavelength does not depend on the kinetic energy

C) Decrease

D) None of the above

Q.2 **What is the de-Broglie wavelength of the α - particle accelerated through a potential difference V**

A) $\frac{0.287}{\sqrt{V}}$ Å

B) $\frac{0.101}{\sqrt{V}}$ Å

C) $\frac{12.27}{\sqrt{V}}$ Å

D) $\frac{0.202}{\sqrt{V}}$ Å

Q.3 **The momentum of a photon is 2×10^{-16} gm-cm/sec. Its energy is**

A) 0.61×10^{-26} erg

B) 6×10^{-6} erg

C) 2.0×10^{-26} erg

D) 6×10^{-6} erg

Q.4 **If we express the energy of a photon in KeV and the wavelength in angstroms, then energy of a photon can be calculated from the relation**

A) $E = 12.4h\nu$

B) $E = 12.4/\lambda$

C) $E = 12.4h/\lambda$

D) $E = h\nu$

Q.5 **If the work function of a metal is φ and the frequency of the incident light is ν, there is no emission of photoelectron if**

A) $\nu < \frac{\varphi}{h}$

B) $\nu > \frac{\varphi}{h}$

C) $\nu = \frac{\varphi}{h}$

D) $\nu >=< \frac{\varphi}{h}$

Q.6 **If the incident electrons in Coolidge tube are accelerated through a potential of V volt, then the maximum frequency of continuous X-rays will be**

A) V

B) $\frac{eV}{h}$

C) hV

D) $\frac{h}{eV}$

Q.7 **If anode potential of X-rays tube increase then**

A) Bremsstrahlung radiation wavelength increases

B) Characteristic wavelength increases

C) Bremsstrahlung radiation wavelength decreases

D) Characteristic wavelength decreases

Q.8 **Electrons of mass m and charge e are accelerated through a potential difference V and strike the target. The maximum speed of these electrons is**

A) [illegible]

B) [illegible]

C) $\sqrt{\frac{eV}{m}}$

D) $\sqrt{\frac{2eV}{m}}$

... cannot produce

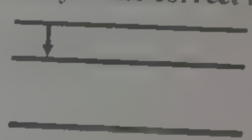
C) Electron-positron pair
D) All of the above

... region is situated between
A) ... and short radio wave regions
B) ...traviolet and visible regions
C) γ-rays and ultraviolet regions
D) Short and long radio wave regions

Q.11 When electrons lose their all K.E in striking target, then X-rays having K.E

A) K.E = V
B) $K.E = \frac{h\lambda_{min}}{c}$
C) $K.E = \frac{hc}{\lambda_{min}}$
D) $K.E = \frac{h}{\lambda_{min}}$

Q.12 Transition gives rise to an X-rays. The correct label for this



A) L_α
B) L_β
C) K_α
D) K_β

Q.13 High energy photon emitted due to transition of inner shell electrons in heavy atom are called

A) K-photons
B) Heavy photons
C) Continuous X-Rays
D) Characteristics X-Rays

Q.14 $(K.E.)_{max} = hf - hf_o$ is known as:

A) Compton equation
B) planks equation
C) Newton's equation
D) photoelectric equation

Q.15 Characteristic X-rays are produced by energy changes in

A) The nucleus
B) Electron far from the nucleus
C) Electrons close to the nucleus
D) Electrons and protons

Q.16 An X-ray photon produced due to transition of electron from M-shell to K-shell is called:

A) K_α
B) K_γ
C) K_β
D) none of these

Q.17 Which of the following X-rays has greater intensity?

A) K_α
B) K_β
C) K_γ
D) All have same

Q.18 Kinetic energy of electrons by applying potential difference V_1 across the X-ray tube is KE_1 while V_2 potential difference produces kinetic energy equal to KE_2. What will be the value of $KE_1 : KE_2$ if ratio of potential difference $V_1 : V_2 = 2:3$?

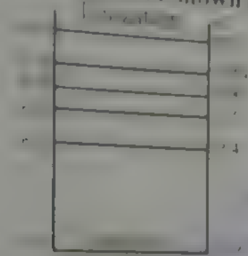
A) 3:2
B) 4:9
C) 9:4
D) 2:3

... photoelectric effect from a small metal plate. Which of the ... in the figure may represent the photocurrent as a function of the distance between the source and the metal?

C) c

D) d

... Some of the energy levels of hydrogen are shown below (not to scale).



Which transition will result in the emission of the photon with the greatest energy?

C) n = 5 to n = 3

D) n = 2 to n = 1

21 Stopping potential does not depend upon

C) Wavelength of light

D) All of these

22 If the electron in a hydrogen atom jumps from the third orbit to second orbit the emitted radiation has wavelength

C) 6/5 R

D) 5 R/6

23 A photon whose energy is E_p joules strikes a photosensitive surface whose work function is ϕ joules. The maximum energy of the ejected photoelectron is equal to

D) $E_p - \phi$

24 An electron of hydrogen is present in the –3.4 eV energy state. Find the angular momentum of the electron

C) $\frac{3h}{2\pi}$

D) $\frac{4h}{\pi}$

... In terms of the Bohr radius ... the radius of the second Bohr orbit of a hydrogen atom is given by

Q.26 The ratio of the K.E & the P.E of electron in hydrogen atom will be.

A) [illegible]
B) [illegible]
C) 2 : 1
D) -2 : 1

Q.27 The experimental value of Rydberg constant is

A) $1.097 \times 10^{-8}\ m^{-1}$
B) $1.097 \times 10^{7}\ m^{-1}$
C) $1.097 \times 10^{8}\ m^{-1}$
D) $1.097 \times 10^{[illegible]}\ m$

Q.28 Number of the emission spectra are

A) One
B) Two
C) Three
D) Four

Q.29 The classical theory cannot explain the dependence of photo emission on

A) frequency of light
B) threshold frequency of light
C) speed of light
D) none of these

Q.30 A Balmer line is emitted when the electron in a hydrogen atom jumps from

A) a higher orbit to the first orbit
B) a higher orbit to the second orbit
C) the first orbit to a higher orbit
D) the second orbit to a higher orbit

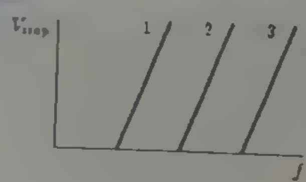
Q.31 What is the de Broglie wavelength of a proton whose linear momentum has a magnitude of 3.3×10^{-23} kg m/s?

A) 0.0002 nm
B) 0.02 nm
C) 0.002 nm
D) 0.2 nm

Q.32 If the wavelength of incident radiation in a photoelectric experiment is decreased then

A) The photoelectric current will decrease
B) The stopping potential will decrease
C) The photoelectric current will increase
D) The stopping potential will increase

Q.33 The diagram shows the graphs of the stopping potential as a function of the frequency of the incident light for photoelectric experiments performed on three different materials. Rank the materials according to the values of their work functions, from least to greatest



A) 1, 2, 3
B) 1, 3, 2
C) 2, 1, 3
D) 3, 2, 1

Q.34 The velocity of a particle of mass m of de-Broglie wavelength λ is ______

A) $\dfrac{2h}{m\lambda}$
B) 2 mλc
C) $\dfrac{m\lambda c^2}{h}$
D) h mλ

Q.35 Ratio of momentum of photons having wavelength 4000 angstrom and 8000 angstrom is

A) 2 : 1
B) 20 : 1
C) 1 : 2
D) 1 : 20

Q.36 **The curve drawn between velocity and frequency of photon in vacuum will be a**

A) straight line parallel to velocity axis

B) straight line passing through origin and making an angle of 45° with frequency axis

C) hyperbola

D) straight line parallel to frequency axis

Q.37 **A radio station emits 10 kW power of 90.8 MHz. Find the number of photon emitted per second**

A) 1.6×10^{28}

B) $1.6 \times 10^{[illegible]}$

C) 1.6×10^{29}

D) 1.6×10^{32}

Q.38 **The energy of a photon is 3×10^{-19} J. Its momentum is**

A) 10^{-27} kg ms^{-1}

B) 10^{-11} kg ms^{-1}

C) $9 \times 10^{-1[illegible]}$ kg ms

D) $3 \times 10^{-[illegible]}$ kg ms^{-1}

Q.39 **Wave nature of light appears in**

A) pair production

B) photoelectric effect

C) Compton effect

D) interference

Q.40 **The radius of electron's second stationary orbit in Bohr's atom is R. The radius of the third orbit will be**

A) 3 R

B) 2.25 R

C) 9 R

D) $\frac{R}{3}$

Q.41 **The free electrons from a metal surface can be taken out by the process**

A) thermionic emission

B) field emission

C) photoelectric emission

D) all of these

Q.42 **Dual nature of radiation is shown by**

A) diffraction and reflection

B) reflection and diffraction

C) photoelectric effect alone

D) photoelectric effect and diffraction

Q.43 **Light of wavelength λ falls on a metal having work function hc/λ_0. Photoelectric effect will take place only if**

A) $\lambda \geq \lambda_0$

B) $\lambda \geq 2\lambda_0$

C) $\lambda \leq \lambda_0$

D) $\lambda < \lambda_0 / 2$

Q.44 **The mass of a photon at rest is**

A) 1 a.m.u.

B) 1.67×10^{-35} kg

C) 9×10^{-31} kg

D) zero

Q.45 **If the wavelength of light incident on the surface of a metal is decreased, the maximum velocity of emitted photo-electrons will**

A) decrease

B) increase

C) not change

D) initially decrease and then increase

Q.46 **The equation E = pc is valid**

A) for an electron as well as for a photon

B) for an electron but not for a photon

C) for a photon but not for an electron

D) neither for an electron nor for a photon

Q.47 **If E_1, E_2 and E_3 are the respective kinetic energies of an electron, an alpha particle and a proton, each having the same de-Broglie wavelength, then**

A) [illegible]

B) [illegible]

C) $E_1 > E_2 > E_3$

D) $E_1 = E_2 = E_3$

Q.48 A photon of energy of 3.4 eV is incident on a metal having work function 2 eV. The maximum K.E of photoelectrons is equal to

A) 1.4 eV
B) [illegible]
C) 5.4 eV
D) 6.8 eV

Q.49 If λ_1 and λ_2 denote the wavelengths of de-Broglie waves for electrons in the first and second Bohr orbits in hydrogen atom, then $\frac{\lambda_1}{\lambda_2}$ is equal to

A) $\frac{2}{1}$
B) $\frac{1}{2}$
C) $\frac{1}{4}$
D) $\frac{4}{1}$

Q.50 Let p and E denote the linear momentum and energy respectively of a photon. If the wavelength is decreased,

A) both p and E increases
B) p increases and E decreases
C) p decreases and E increases
D) both p and E decreases

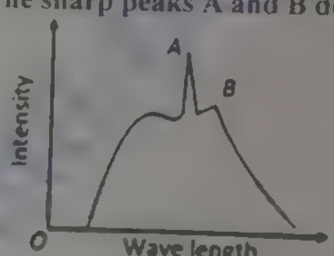
Q.51 The momentum of a photon is p. The frequency associated with it is given by

A) pc/h
B) ph/c
C) hc/p
D) h/pc

Q.52 If the energy of a photon is 25 eV and the work function of the material is 7 eV, then the value of stopping potential is

A) 3 V
B) 9 V
C) 18 V
D) 27 V

Q.53 The figure represents the observed intensity of X-rays emitted by an X-ray tube as a function of wavelength. The sharp peaks A and B denote



A) Band spectrum
B) Continuous spectrum
C) Characteristic radiations
D) White radiations

Q.54 An X-ray tube is operated at 50 kV. The minimum wavelength produced is

A) 0.5 Å
B) 0.75 Å
C) 0.25 Å
D) 1 Å

Q.55 Which of the following wavelength falls in X-ray region?

A) 10000 Å
B) 1000 Å
C) 1 Å
D) 10^2 Å

Q.56 A beam of light of wavelength λ and with illumination L falls on a clean surface of sodium. If N photoelectrons are emitted each with kinetic energy E, then

A) $N \propto L$ and $E \propto L$
B) $N \propto \lambda$ and $E \propto l$
C) $N \propto L$ and $E \propto \frac{1}{\lambda}$
D) $N \propto \frac{1}{\lambda}$ and $E \propto \frac{1}{L}$

Q.57 A potential difference of 42,000 *volts* is used in an *X*-ray tube to accelerate electrons. The maximum frequency of the *X* radiations produced is

A) [illegible] Hz
B) 10^{16} Hz
C) 10^{18} Hz
D) 10^{20} Hz

Q.58 The wavelength of most energetic *X*-rays emitted when a metal target is bombarded by 40*KeV* electrons, is approximately

$(h = 6.62\times10^{-34}\ J\text{-}sec;\ 1\ eV = 1.6\times10^{-19}\ J;\ c = 3\times10^{8}\ m/s)$

A) 300 Å
B) 4 Å
C) 10 Å
D) 0.31 Å

Q.59 What is the difference between soft and hard *X*-rays

A) Velocity
B) Frequency
C) Intensity
D) Polarization

Q.60 The wavelength of X-rays decreases, when

A) Temperature of target is increased
B) K.E. of electrons striking the target is increased
C) Intensity of electron beam is increased
D) K.E. of electrons striking the target is decreased

ANSWER KEY

1	C	11	C	21	B	31	B	41	D	51	A
2	B	12	A	22	B	32	D	42	D	52	C
3	B	13	D	23	D	33	A	43	C	53	C
4	B	14	D	24	B	34	D	44	D	54	C
5	A	15	C	25	A	35	A	45	B	55	C
6	B	16	C	26	B	36	D	46	C	56	C
7	C	17	A	27	B	37	C	47	A	57	A
8	D	18	D	28	C	38	A	48	A	58	D
9	C	19	D	29	B	39	D	49	B	59	B
10	C	20	D	30	B	40	B	50	A	60	B

11 UNIT

NUCLEAR PHYSICS

SELF ASSESSMENT TEST

Q.1 Binding energy of a nucleus is

A) Energy given to its nucleus during its formation

B) Loss of energy from the nucleus during its formation

C) Total mass of nucleus converted to energy units

D) Total K.E. and P.E. of the nucleons in the nucleus

Q.2 A chain reaction is continuous due to

A) Large mass defect

B) Production of more neutrons in fission

C) Large energy

D) None of these

Q.3 In a radioactive substance at $t = 0$, the number of atoms is 8×10^{1}. Its half life period is 3 years. The number of atoms 1×10^{4} will remain after interval

A) 9 years | C) 8 years

B) 6 years | D) 24 years

Q.4 If the decay or disintegration constant of a radioactive substance is λ, then its half life and mean life are respectively

A) $\frac{1}{\lambda}$ and $\frac{\log_e 2}{\lambda}$ | C) $\frac{\log_e 2}{\lambda}$ and $\frac{1}{\lambda}$

B) $\lambda \log_e 2$ and $\frac{1}{\lambda}$ | D) $\frac{\lambda}{\log_e 2}$ and $\frac{1}{\lambda}$

Q.5 A radioactive element emits 200 particles per second. After three hours 25 particles per second are emitted. The half life period of element will be

A) 50 minutes | C) 60 minutes

B) 70 minutes | D) 80 minutes

Q.6 Half-life of a radioactive material depends on:

A) Temperature | C) Nature of the material

B) Quantity of the material | D) All

Q.7 What fraction of a radioactive material will get disintegrated in a period of two half-lives?

A) Whole | C) Half

B) One-fourth | D) Three-fourth

Q.8 Three fourths of the radioactive nuclei present in a radioactive sample decay in $\frac{3}{4}s$. The half-life of the sample is:

A) $\frac{3}{4}s$ | C) $\frac{3}{8}s$

B) $1\,s$ | D) $\frac{1}{2}s$

Q.9 When a radioactive isotope $_{88}Ra^{228}$ decays in series by the emission of three α particles ... the isotope finally formed is

C) $_{86}X^{222}$

10 The phenomenon of spontaneous disintegration of heavier elements ($Z>82$) into lighter nuclei with the emission of three types of radiation is

A) [illegible]
B) [illegible]
C) Conductivity
D) Population inversion

Which one of the following is undeflected by electric or magnetic field?

A) [illegible]
B) [illegible]
C) α-particles
D) γ-particles

One curie is equal to

A) 3.70×10^{10} Bq
B) 3.70×10^{10} Henry
C) 3.7×10^{16} Bq
D) 3.7×10^{25} Bq

13 The percentage of the original of a radioactive material left after five half-lives is approximately:

A) 1%
B) 5%
C) 3%
D) 20%

Q.14 The half-life of a radioactive element which has only $\frac{1}{32}$ of its original mass left after a lapse of 60 days is:

A) 12 days
B) 60 days
C) 32 days
D) 64 days

15 In the following nuclear reaction, how many α and β particles are emitted?

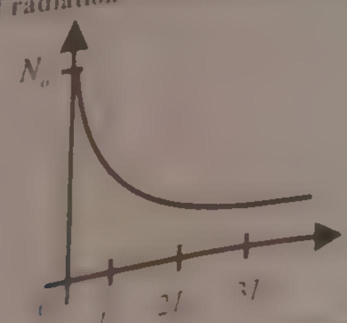
$X^{235} \rightarrow {}_{82}Y^{207}$

A) 3 α-particles and 2 β-particles
B) 6 α-particles and 2 β-particles
C) 7 α-particles and 4 β-particles
D) 4 α-particles and 2 β-particles

A substance reduces to $\frac{1}{16}$th of its original mass in 2 hours. The half-life period of the substance is:

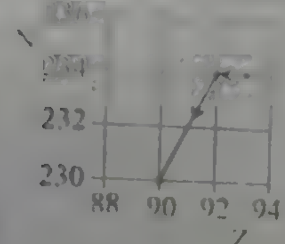
A) 120 min
B) 30 min
C) 15 min
D) 60 min

The graph for half-life of radiations is shown in fig. The graph is called:

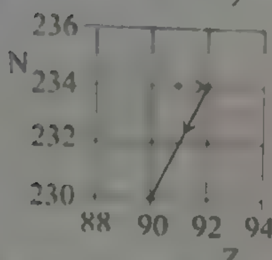


A) Linear curve
C) [illegible] curve
D) [illegible] curve

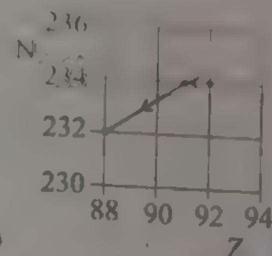
Q.18 A radioactive nucleus is formed by β decay. This nucleus then decays by α emission. Which graph of proton number Z plotted against nucleon number N shown the β-decay followed by the α-emission?



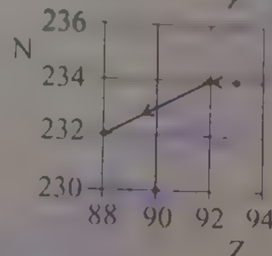
A)



B)



C)



D)

Q.19 The fission of U^{238} is possible by

A) Only fast neutrons

B) Fast as well as slow neutrons

C) Only slow neutrons

D) Fast protons

Q.20 Which element was used in atomic bombs dropped at Hiroshima and Nagasaki

A) Uranium

B) radium

C) protactinium

D) Plutonium

Q.21 How many up quarks and down quarks must a proton contain?

	Up quarks	Down quarks
A)	0	3
B)	1	1
C)	1	2
D)	2	1

Q.22 One reaction which might be used for controlled nuclear fusion is shown.

$$^{7}_{3}Li + ^{2}_{1}H \longrightarrow 2(^{4}_{2}He) + X$$

What is particle X?

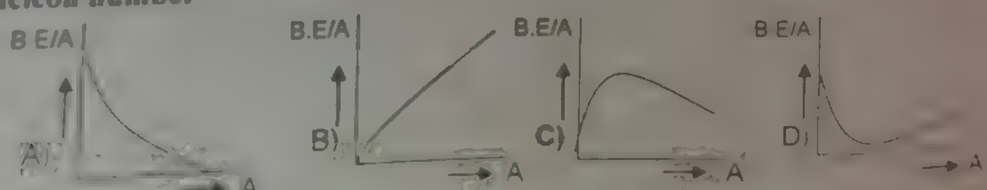
A) An α-particle

B) An electron

C) A neutron

D) A proton

Q.23 Which sketch graph best represents the variation of binding energy per nucleon with nucleon number



Q.24 Which of the following factor measure the stability of radioactive element?

A) average live

B) Total life

C) Half life

D) All of these

Q.25 **For atomic nucleus, the binding energy per nucleon ____ with increase in mass number**
A) Increases continuously
B) Decrease continuously
C) Remains constant
D) First increases and then decreases

Q.26 **The best place to store/dump nuclear waste is**
A) Under the sea
B) Into the soil
C) Under the old salt mines
D) All of these

Q.27 **A fusion reaction is initiated with help of**
A) High temperature
B) Neutrons
C) Low temperature
D) α particles

Q.28 **The mass of the nucleus is always less that the total mass of the protons and neutrons that make up the nucleus. The difference of the two masses is called**
A) Mass defect
B) Binding energy
C) Mass excess
D) Packing fraction

Q.29 **Quarks are basic building block of**
A) Mesons
B) Electrons
C) Baryons
D) A and C

Q.30 **One atomic mass unit is equal to**
A) Mass of one atom of hydrogen
B) Mass of one atom of ${}_6C^{12}$
C) $\frac{1}{12^{th}}$ of the mass of one atom of ${}_6C^{12}$
D) 10^{-27} kg

Q.31 **${}^{90}_{38}Sr$ decays to ${}^{90}_{39}Y$ by**
A) emission of α-particles
B) emission of β-particles
C) emission of 1α and 2β particles
D) absorption of electrons

Q.32 **The value of A in the following reaction is**

$${}_4Be^9 + {}_2He^4 = {}_6C^A + {}_0n^1$$

A) 14
B) 12
C) 10
D) 16

Q.33 **The radioactivity of a certain radioactive element drops to 1/64 of its initial value in 30 seconds. Its half-life is**
A) 4 seconds
B) 3 seconds
C) 5 seconds
D) 2 seconds

Q.34 **The fraction of atoms of radioactive element that decays in 6 days is 7/8. The fraction that decays in 10 days will be**
A) 77/80
B) 71/80
C) 31/32
D) 15/16

Q.35 **The decay constant of radium is 4.28×10^{-4} per year. Its half-life will be**
A) 1240 years
B) 2000 years
C) 1620 years
D) 63 years

Q.36 **A sample contains 16 gm of a radioactive material, the half-life of which is two days. After 32 days, the amount of radioactive material left in the sample is**
A) 14 gm
B) less than 1 mg
C) 12 gm
D) 1 gm

Q.37 **The decay constant of a radioactive element is 0.01 per second. Its half-life period is**
A) 0.693 sec
B) 69.3 sec
C) 6.93 sec
D) 693 sec

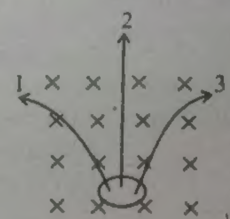
Q.38 A radioactive nucleus $_{92}X^{235}$ decays to $_{91}Y^{231}$. Which of the following particles are emitted

A) two deuterons and one positron
B) one alpha and one electron
C) one alpha and one proton
D) one proton and four neutrons

Q.39 The half-life period of a radioactive substance is 5 min. The amount of substance decayed in 20 min will be

A) 75%
B) 25%
C) 93.75%
D) 6.25%

Q.40 Nuclear radiation when subjected under magnetic field defects as shown below, 1, 2 and 3 denotes respectively:



A) α, β, γ
B) γ, β, α
C) α, γ, β
D) β, γ, α

Q.41 Neutron decay in the free space is given as follows

$$_0n^1 \rightarrow {}_1H^1 + {}_{-1}e^0 + [\ ]$$

Then the parenthesis represents an

A) Photon
B) graviton
C) neutrino
D) antineutrino

Q.42 The difference between U^{235} and U^{238} atom is that

A) U^{238} contains 3 more protons
B) U^{238} contains 3 more protons and 3 more electrons.
C) U^{238} contains 3 more neutrons and 3 more electrons.
D) U^{238} contains 3 more neutrons.

Q.43 The half-life of a certain radioactive element is such that $\frac{7}{8}$ of a given quantity decays in 12 days. What fraction remains undecayed after 24 days?

A) 0
B) $\frac{1}{128}$
C) $\frac{1}{64}$
D) $\frac{1}{32}$

Q.44 Fusion reaction takes place at high temperature because

A) atoms are ionized at high temperature
B) molecules break-up at high temperature
C) nuclei break-up at high temperature
D) kinetic energy is high enough to overcome repulsion between nuclei

Q.45 The nuclei of which one of the following pairs of nuclei are isotones?

A) $_{34}Se^{74}$, $_{31}Ga^{71}$
B) $_{20}Ca^{40}$, $_{16}S^{32}$
C) $_{42}Mo^{92}$, $_{40}Zr^{92}$
D) $_{38}Sr^{84}$, $_{38}Sr^{86}$

Q.46 **In any fission process the ratio** $\frac{\text{mass of fission products}}{\text{mass of parents nucleus}}$ **is:**

A) less than 1
B) equal to 1
C) depends on the mass of the parent nucleus
D) greater than 1

Q.47 **When boron-11** $\left(^{11}_{5}B\right)$ **is bombarded with** α **-particle, a new nucleus is formed and a neutron is released.**
Which nuclear equation could represent this reaction?

A) $^{11}_{5}B + ^{4}_{2}He \rightarrow ^{11}_{6}C + ^{1}_{0}n$
B) $^{11}_{5}B + ^{4}_{2}He \rightarrow ^{13}_{7}N + ^{1}_{0}n$
C) $^{11}_{5}B + ^{4}_{2}He \rightarrow ^{14}_{6}C + ^{1}_{1}n$
D) $^{11}_{5}B + ^{4}_{2}He \rightarrow ^{14}_{7}N + ^{1}_{0}n$

Q.48 **A sample contains 10 mg of radio-active material of half-life 270 days. After 540 days the mass of radio-active material left will be**

A) 5 mg
B) 2.5 mg
C) 1.25 mg
D) zero

Q.49 **In the disintegration series**

$$^{238}_{92}U \xrightarrow{\alpha} X \xrightarrow{\beta} {}^{A}_{Z}U$$

The values of Z and A respectively will be

A) 92, 236
B) 88, 230
C) 90, 234
D) 91, 234

Q.50 **After 280 days, the activity of radioactive sample is 6000 disintegration per second. The activity reduces to 3000 disintegration per second after an-other 140 days. The initial activity of the sample in disintegration per second is**

A) 6000
B) 9000
C) 3000
D) 24000

Q.51 **Which of the following cannot be emitted by radioactive substance during their decay?**

A) electrons
B) protons
C) neutrinos
D) helium nuclei

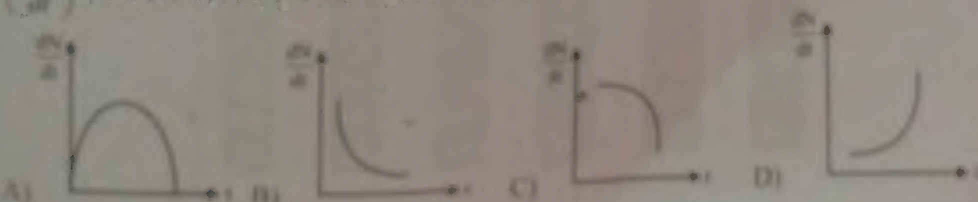
Q.52 **1 amu is equivalent to**

A) 931 MeV
B) 931 keV
C) 391 MeV
D) 391 keV

Q.53 **The radioactivity of a certain radioactive element drops to 1/64 of its initial value in 30 second. Its half-life is**

A) 2 second
B) 4 second
C) 5 second
D) 6 second

Q.54 **Radioactive element decays to form a stable nuclide, then the rate of decay of reactant** $\left(\frac{dN}{dt}\right)$ **will vary with time (t) as shown in figure**



Q.55 The table shows the possible properties of radioactive emissions. Which emission could be a beta-particle?

	Charged	Deflected in a magnetic field	Level of ionization
A)	No	Yes	None
B)	Yes	Yes	None
C)	Yes	Yes	Weak
D)	Yes	No	Weak

Q.56 What are the correct descriptions of a γ-ray and a β-particle?

	γ-ray	β-particle
A	High-speed electron	Electromagnetic radiation
B	Electromagnetic radiation	Helium-4 nucleus
C	Electromagnetic radiation	High-speed electron
D	High-speed electron	Helium-4 nucleus

Q.57 Curie is a unit of
A) Length
B) It is not any unit
C) Activity
D) Atomic number

Q.58 The amount of energy released in the fusion of four hydrogen nuclei to form an alpha particle is equal to
A) 2MeV
B) 100 MeV
C) 25 MeV
D) 200 MeV

Q.59 The half-life of radon is 3.8 days. Three forth of a radon sample decay in
A) 5.02 days
B) 7.6 days
C) 15.2 days
D) 11.4 days

Q.60 The composition of an α-particle can be expressed as
A) 1P + 1N
B) 2P + 1N
C) 1P + 2N
D) 2P + 2N

ANSWER KEY

1	B	11	D	21	D	31	B	41	D	51	B
2	B	12	A	22	C	32	B	42	D	52	A
3	A	13	C	23	C	33	C	43	C	53	C
4	C	14	A	24	C	34	C	44	D	54	B
5	C	15	C	25	D	35	C	45	A	55	C
6	C	16	B	26	C	36	B	46	A	56	C
7	D	17	D	27	A	37	B	47	D	57	C
8	C	18	B	28	A	38	B	48	B	58	C
9	A	19	A	29	D	39	C	49	D	59	B
10	A	20	D	30	C	40	C	50	D	60	D